Fresno DFG SEIR

11/16/09

Submitted by

R.C.M. Enterprises

850 San Jose Ave #110

Clovis, Ca 93612

Questions

1 Why are Mineral Resources not included in the CEQA study?

2 Why is the Environmentalist study so biased against property owners?

3 Why are the benefits of dredging not included in the study material?

4 If questions are to be directed at material in the study, where do we put the positive effects of dredging?

Page. 28 *& 29

Notice of Preparation / Initial Study

Project No. 09.005

The environmental factors checked below would potentially be affected by this project

(i.e., the project would involve at least one impact that is a "Potentially Significant Impact"), as indicated by the check list on the following pages.

CHECK LIST

Aesthetics (checked)

Air Quality (checked)

Biological Resources (checked)

Cultural Resources (checked)

Hazards and Hazardous Materials (checked)

Hydrology/Water Quality (checked)

Noise (checked)

Recreation (checked)

Mandatory Findings of Significance (checked)

Mineral Resources (NOT CHECKED)

Signed, John McCamman, Chief Deputy Director 10/26/09

The Chief Deputy Director of CDFG has made a knowingly deliberate and false official written statement, by not checking the "Mineral Resources" checklist box in this official CEQA initial study report. It is significant in several aspects.

It is common knowledge that gold, platinum and other associated extremely valuable minerals are Mineral Resources.

It is common knowledge that these valuable mineral resources certainly exist as placer deposits, within waterways throughout California.

It is common knowledge and utterly indisputable that "suction dredging" is a widespread modern, efficient small scale mining method throughout California. Clearly, that is what triggered this CEQA study.

It is common Knowledge that small scale suction dredging is usually profitable. Otherwise, no prudent person would invest in a suction dredge or spend time performing the intense labor to do it.

It is common knowledge that relatively significant amounts of gold and other valuable minerals are recovered by small scale suction dredging annually in California.

Given this indisputable series of facts. It is not possible or reality, that the Chief Deputy Director of CDFG, the very state agency that regulates all suction dredge permitting statewide, could assert that small scale "suction dredging" does not involve, nor have significant impact on "Mineral Resources" within California.

The reason the box is unchecked would be because it involves CEQA and SMARA provisions.

Given that provisions of CEQA mandate SMARA application in a CEQA project, if "Mineral Resources" are involved. Another set of governing standards must be included within this CEQA process, otherwise it is fundamentally flawed from the onset , and any result or determination made within it is illegitimate and contrary to law.

Obviously, CDFG must have an Attorney Generals legal opinion to clarify how they can proceed. Once they have written notice, or accept verbal or written comment regarding SMARA and facts pointed out here. They cannot deny actual or constructive notice of it. And cannot proceed without inclusion of SMARA.

3.3.15 Mineral Resources

Introduction

The purpose of the Mineral Resources section is to identify and evaluate the potential for the project to adversely affect the availability of known mineral resources. The mineral resources of concern include metals, industrial minerals (e.g., aggregate, sand and gravel), oil and gas, and geothermal resources that would be of value to the region and residents of the State.

Responsible Agencies

The protection of mineral resources in California is the responsibility of the following agencies, which either have statutory authority or are Responsible Agencies under CEQA:

- *California Department of Conservation* http://www.consrv.ca.gov is the primary agency with regard to mineral resource protection. The Department is charged with conserving earth resources (*Public Resources Code Sections 600-690*) http://www.leginfo.ca.gov and has five program divisions that address mineral resource issues: *Division of Mines and Geology*, http://www.consrv.ca.gov/dmg *Division of Oil, Gas and Geothermal Resources*, http://www.consrv.ca.gov/dog/ *Division of Land Resource Protection*, http://www.consrv.ca.gov/dlrp *Division of Recycling*, http://www.consrv.ca.gov/dor/ and *Office of Mine Reclamation* http://www.consrv.ca.gov/omr.

- *State Mining and Geology Board*, which develops policy direction regarding the development and conservation of mineral resources and reclamation of mined lands. http://www.consrv.ca.gov/smgb/

Other State agencies with Statutory Authority or that may wish to comment on the environmental document with regard to mineral resources issues include:

- State Lands Commission

- Coastal Commission (for land uses that could affect access to mineral resources within the Coastal Zone). (See *UC CEQA Handbook Section 3.3.14*.)

- State Water Resources Control Board (as pertains to mineral resource water quality-related issues),

- Parks and Recreation, Fish and Game, and Energy Commission (*CEQA Guidelines Appendix B*),

See *UC CEQA Handbook Section 3.3.14*, Land Use, for a description of the responsibilities of the State Lands Commission and California Coastal Commission with regard to project or land uses.

LRDP EIR

- The mineral resources impact analysis should focus on the potential loss of availability of the mineral resource due to land use conversions.

Loss of access to mineral resources would primarily be the result of conversion of lands underlain by these resources to other uses, or within close proximity to the resources, such that the construction and occupancy of the project would restrict or eliminate safe and environmentally sound measures to implement extractive operations. Loss of access could also be the result of changes in land ownership (e.g., non-renewal of a lease where active mining is occurring).

Loss of access to mineral resources for the purposes of future extraction could be considered to be primarily an economic issue. According to *CEQA Guidelines Section 15131(a)* http://ceres.ca.gov/topic/env_law/ceqa/guidelines/art9.html purely economic impacts are not considered physical environmental impacts. Notwithstanding, important mineral resource areas are recognized at the federal and State levels through environmental resource management plans and adopted mineral resource mapping, and at the local level through land use planning documents such as general plans that incorporate such information. Therefore, the potential loss of such resources, if any, due to project implementation should be described. If mineral resources could be affected, an assessment of cumulative impacts should also be included.

Potential effects related to land use compatibility (if the project would site new uses adjacent to existing mining operations) are more appropriately discussed in the land use section of the LRDP EIR. If active mining activities were restricted or eliminated by changes in land ownership, it might be necessary to expand or open a mine in another area, which could have significant environmental effects on other natural resources. Such issues should be discussed in the appropriate technical sections of the LRDP EIR.

Project EIR

To the extent not analyzed in an LRDP EIR, the Mineral Resources section of a Project EIR or the IS should analyze whether the project would result in any effects that were not anticipated or evaluated by the LRDP EIR. Further, it should analyze the project in relation to the current LRDP and any existing land use plans.

Standards of Significance

Would the project:

- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State?

- Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?

- Exceed an applicable LRDP or program EIR standard of significance? This question enables the campus to define a campus specific standard of significance.

Analytical Methods

- The environmental analysis must evaluate site-specific characteristics in relation to the type and extent of proposed changes in land use.

- The Mineral Resources section of the EIR or Tiered Initial Study should identify the locations of mineral resources relative to the project site.

Sections 2761(a) and (b) and 2790 of the State's *Surface Mining and Reclamation Act (SMARA)* provide for a mineral lands inventory process termed classification-designation. The California Division of Mines and Geology, and the State Mining and Geology Board http://www.consrv.ca.gov/smgb/ are responsible for administering this process and have statutory authority. Areas are classified on the basis of geologic factors, without regard to existing land use and land ownership. The areas are categorized into four Mineral Resource Zones (MRZs). Of the four categories, lands classified as MRZ-2 are of the greatest importance. Such areas are underlain by demonstrated mineral resources where geologic data indicate significant measured or indicated resources are present. MRZ-2 areas designated by the Mining and Geology Board as "regionally significant" are incorporated by regulation into Title 14, Division 2 of the California Code of Regulations. Such designations require that a lead agency's land use decisions involving designated areas be made in accordance with its mineral resource management policies, and that it consider the importance of the mineral resource to the region or the state as a whole, not just to the lead agency's jurisdiction.

The primary source of information considered in the analysis is the "mineral lands classification" maps published by the State pursuant to SMARA, as described above. Reports containing these maps are listed in *Publications Available from the Division of Mines and Geology.* http://www.consrv.ca.gov/dmg Digital data is currently available for some locations and may be obtained by contacting the Division of Mines and Geology. Locations of areas classified MRZ-2 on the classification maps and their proximity to project development should be depicted graphically and described in the text, based on information provided in the published report. If mineral lands classification mapping has not been published, that should be noted. In lieu of such information, the local general plan or applicable environmental plan should be consulted to determine whether any mineral resource land use designations have been adopted, or if there are other land use or zoning designations that allow for mineral extraction. Finally, two comprehensive databases managed by the U.S. Geological Survey (*Minerals Availability System* and *Mineral Resource Data System*) http://www.mrdata.usgs.gov contain substantial amounts of information regarding specific mineral locations. However, interpretation of the data and its relevance to the mineral resources analysis in the EIR or Tiered Initial Study (TIS) should be limited to a general discussion and should not be used solely to determine potential effects.

Local general plans are required to incorporate the above-mentioned information where MRZ-2 classifications or regionally significant designations have been published. Although the University of

California is constitutionally exempt from local land use planning requirements, information contained in the local plans is valuable, and should be considered.

The data listed above may be assumed to reasonably indicate the potential for resources of local or regional significance. Consultation with the local land use jurisdiction regarding active and pending mining permits and status of reclamation plans may also provide useful information, along with review of the most current edition of *Mines and Mineral Producers Active in California*, Division of Mines and Geology Special Publication 103. If such information is available, mineral rights, patents, and claims should also be identified.

Once information has been gathered from the above-mentioned sources as to the existence of valuable mineral resources, the determination must be made as to whether the project would affect them.

Generally Feasible Mitigation Measures

- Avoid siting project land uses in areas classified MRZ-2 or designated as "regionally significant" by the State Geologist where feasible.

- Where MRZ-2 or "regionally significant" areas have not been identified, avoid siting project land uses in mineral resource areas formally identified in local general plans, specific plans, or relevant environmental plans, or where site-specific information evaluated by a geologist registered in the State of California suggests the potential for a mineral deposit of economic value as feasible.

- Consult with local planning jurisdictions prior to adopting any land use change that could restrict or eliminate mineral deposits identified as MRZ-2, regionally significant, or identified by the local land use jurisdiction, or that would interfere with active mining operations. The purpose of this consultation is to identify potential land use conflicts and to cooperate with the local jurisdiction so that it can fulfill its obligations under the Public Resources Code and SMARA.

From: <lyra@srrc.org>
To: <dfgsuctiondredge@dfg.ca.gov>
Date: 12/3/2009 4:53 PM
Subject: SRRC comments for Suction Dredge Permitting and SEIR
Attachments: SRRC Comments on Suction Dredge EIR.doc

Mark -
Please find the Salmon River Restoration Council's comments attached,

Thank you,

Lyra Cressey
Salmon River Restoration Council
(530) 462-4665

Salmon River Restoration Council

PO Box 1089 ♦ 25631 Sawyers Bar Rd ♦ Sawyers Bar, CA 96027
Email: info@srrc.org ♦ webpage: www.srrc.org
Phone: (530) 462-4665 ♦ fax: (530)462-4664

November 3, 2009

Mark Stopher
California Department of Fish and Game
601 Locust Street
Redding, CA 96001

Subject: Initial Study for Suction Dredge Permitting Program and Subsequent Environmental Impact Report

To: California Department of Fish and Game
From: Salmon River Restoration Council

Dear Mr. Stopher,

Thank you for this opportunity to comment on the Initial Study for Suction Dredge Permitting and SEIR. The Salmon River is a uniquely unimpaired watershed and provides excellent habitat for fish and other aquatic life. Poorly regulated suction dredge activities have a negative impact on this important resource.

The Salmon River has numerous statutory protections for fisheries and water quality including:

- Clean Water Act 303(d) listing for temperature impairment
- National and California Wild and Scenic designations for the Mainstem Salmon River, Wooley Creek, and almost all of the North Fork and South Fork Salmon River. Outstandingly remarkable and extraordinary values include fisheries and water quality.
- Key Watershed designation in Aquatic Conservation Strategy in Northwest Forest Plan of 1994

Activities permitted by the Suction Dredge Permitting Program and the Program itself must be in compliance with these laws and designations. Any suction dredging permitted cannot contribute to further impairment of temperature (including effects of turbidity on temperature), cannot negatively impact Wild and Scenic values, and must not interfere with the goals of the Aquatic Conservation Strategy.

Deleterious Effects

CDFG is authorized to permit suction dredge mining only if it is shown not to have a "deleterious effect" on fish. This should require a thorough examination of every mining operation prior to issuance of a permit. Simply issuing a ministerial permit that allows dredging without first specifically determining whether the mining is deleterious to fish is not legal.

The Department claims to use a "common sense plain" definition of deleterious. The definition given is, "…deleterious effect generally means a wide-ranging or long-lasting consequence for a fish population that extends beyond the temporal or special context of a specific direct impact. Such deleterious effects could include the following: (1) Catch, capture, kill, or injure a species listed as candidate, threatened or endangered under the state or federal Endangered Species Act; (2) A substantial reduction in the range of any species, and/or extirpation of a population; (3) A fundamental change to the structure of a community or stream ecosystem, including substantial reductions in biodiversity or resiliency to disturbance, resulting in the reasonably foreseeable consequence of (1) or (2) above."[1]

Merriam-Webster on the other hand, defines deleterious as "harmful often in a subtle or unexpected way". This should be used as the "common sense plain" definition and should be the baseline against which the effects of suction dredging will be judged. There is no basis for tying the definition of deleterious to the Endangered Species Act. The effects of dredging can be deleterious without a species being listed under the ESA. For instance, on the Salmon River, we have the last run of wild spring Chinook in the Klamath Basin, which is a remnant repository of important fish genetics, but which has no official ESA designation. Under this definition of deleterious, effects of suction dredging on Salmon River spring Chinook would not even be considered in issuing permits.

Thermal Refugia

Thermal refugia are critical for the day to day survival of multiple species of fish including, coho, juvenile spring and fall Chinook, adult spring Chinook, summer and winter steelhead, and rainbow trout, during the same time period in which suction dredging takes place on the Salmon River (July-September). Suction dredging in or near thermal refugia (deep pools, mouths of streams, springs) may interfere with the ability of fish to utilize these critical areas for their survival and directly affect the health or mortality of these fish. On the Salmon River, a number of popular mining club claims that receive a higher than average degree of use, are located in or near thermal refugia. The Department needs to thoroughly analyze the potential impacts to these critical areas and consider appropriate regulation to allow unimpaired fish access and use of thermal refugia in the Salmon River.

Camping and Land Use

Unlike most areas, the Salmon River is not equipped to handle the ancillary impacts of some recreational activities. Suction dredgers camp for weeks or months at a time on the Salmon River, where there are no septic or sewage facilities. The SRRC has documented cases of improper disposal of human waste at dredgers camps, such as in plastic bags on river bars. The Department needs to address these ancillary suction dredge impacts, including the increased likelihood of their occurrence in remote areas like the Salmon River.

Transport of Invasive Species

Consideration needs to be given to the potential transport of both aquatic and terrestrial invasive species (such as New Zealand mussels, mud snails, algae, noxious weeds, etc) into remote areas by suction dredges. Currently dredge equipment is allowed to be transported throughout the state with no requirements avoiding the spread of invasive species. The Salmon River is currently relatively un-impacted by invasives, and has a healthy native fauna and flora. A concerted effort is being made on the part of the community and land managers to control harmful invasive species on the Salmon. The Department needs to make sure that every measure is taken to prevent their spread.

If you have any questions or additional needs from us, please do not hesitate to contact us. We look forward to continuing to work with CDFG to make the Salmon River a better place for water quality, the fish, the people and for all beneficial uses.

Sincerely,

Lyra Cressey
Water Monitoring Program Coordinator

From: Peter Brucker <ptb92day@gmail.com>
To: <dfgsuctiondredge@dfg.ca.gov>
Date: 12/3/2009 4:54 PM
Subject: SRRC Scoping Comment for the Suction Dredge Permitting Program EIR
Attachments: ATT.1.Overview of the SRRC. Community Restoration Program. 1992-2009. doc.doc; ATT.2. Klamath River Basin Spring-run Chinook.Map of Historic and Current Range.zip

Abstract

From: Petey Brucker, President

Salmon River Restoration Council,

PO Box 1089,

Sawyers Bar, CA

96027

To: Mark Stopher
California Department of Fish and Game (CDFG)
601 Locust Street
Redding, CA 96001
RE: SRRC Scoping Comments to the CDFG for the Suction Dredge Permitting Program EIR

Date: December 3, 2009

Dear Mr. Stopher,

The Salmon River Restoration Council (SRRC) appreciates this opportunity to provide comments to you regarding the suction dredge scoping program EIR currently under way. The SRRC is a community based 501- c- 3 non-profit corporation. The mission of the Salmon River Restoration Council is to assess, protect, restore and maintain the Salmon River ecosystems with the active participation of the local community, focusing on restoration of the anadromous fisheries resources and the development of a sustainable economy. We provide assistance and education to the general public and cooperating agencies by facilitating communication and cooperation between the local communities, managing agencies, Native American Tribes, and other stakeholders.

A key focus of the SRRC is to protect and restore the anadromous fish species of the Salmon River, which include: Coho salmon, spring and fall run Chinook salmon, summer and winter run Steelhead, Pacific Lamprey, Green Sturgeon and other native species. In particular the Salmon River is noted as having one of the last runs of native spring-run Chinook in the Klamath River Basin. The SRRC has been extensively involved in protecting and restoring the spring-run Chinook in the Salmon River. We have subsequently found it necessary to lend similar attention to the entire run of spring-run Chinook in the Klamath River Basin, as recovery of this keystone emblematic species necessitates a meta population approach. Spring-run Chinook are currently at a high risk of extinction.

The SRRC has been an active partner in the development and implementation of the Salmon River Subbasin Restoration Strategy (Strategy) completed by the SRRC and US Forest Service- Klamath National Forest in 2002 and adopted as the TMDL implementation Plan by the North Coast Regional Water Quality Control Board in 2005. Through the SRRC's Salmon River Community Restoration Program, the SRRC has made various contributions to watershed and fisheries resource restoration in the Salmon River and larger Klamath River Basin (See Attachment # 1 - Salmon River Community Restoration Program Overview). The SRRC has been actively engaged with the local suction dredge gold mining community, providing educational materials on the protection and restoration of the above mentioned anadromous fish species.

We are providing you, below, with some background information that we have compiled regarding the status and unique life history of the spring-run Chinook stocks of the Salmon River. To be used in the development of the Department's new regulations for suction dredge gold mining on the Salmon River and for the larger Klamath River Basin. In this background information, provided below, we have also provided some perspective and data for the larger Klamath River Basin run of these fish.

Background on the Status of the Klamath River Basin Spring Chinook salmon, highlighting the Salmon River Stock

Spring-run Chinook salmon (*Oncorhynchus tshawytscha*) were once the dominant run type in the Klamath/Trinity Basin, Spring run populations are at less than 10% of their historic level. At least 7 runs (in the Klamath Basin) are now extinct (NOAA Fisheries –Chinook Status Review 1998). Spring-run Chinook in the Klamath Basin currently utilize an estimated 3 % of their historical habitat (See Attachment # 2- Map of Historic and Current Range of Klamath River Basin spring-run Chinook). Several of these historic stocks proliferated above the dams on the Klamath, Trinity and Shasta rivers. The near extirpation of Spring Chinook in the Klamath River basin indicates potential future problems for other anadromous stocks that rely on freshwater habitats during the juvenile and adult life histories (Salmon, Steelhead, and Trout in California-*Status *of* an Emblematic Fauna, *Moyle 2008).

As shown in Attachment #2 –Historic and Current Range Map, spring-run Chinook species were once found throughout the Klamath Basin. However, passage of spring-run Chinook into their historical range was blocked below Klamath Falls in 1895 by construction of Copco 1 Dam, and on the Shasta River with the construction of Dwinell Dam (Hamilton et al. 2005, Moyle 2008). The large run in the Shasta River disappeared coincidentally with the construction of Dwinnell Dam in 1926 (Moyle et al. 1995). Historically, they were especially abundant in the major tributary basins of the Klamath and Trinity Rivers, such as the Salmon, Scott, Shasta, South Fork and North Fork Trinity Rivers. Due to a legacy of human impacts (i.e. dams, mining, logging, and overfishing), today, only the Salmon River and its two forks maintain a viable population (Moyle 2008).

Both Coho and spring Chinook salmon demonstrate a stream-type life history strategy, where juveniles remain at least a year in freshwater before entering the ocean (Healey 1991), and therefore require coldwater-river conditions like those found in the coldwater system of the Salmon River. Spring run Chinook are distinct from fall run Chinook in that adult spring Chinook enter fresh water in spring and early summer, before their gonads are fully developed and hold in cold water areas for 2-4 months before spawning. Successful juvenile life history strategies require suitable winter rearing habitats, commonly found in off-channel reaches, wetlands and estuary environments.

By the 1980s, spring-run Chinook had been largely eliminated from much of their former habitats because the cold, clear water and deep pools that they require were either absent or inaccessible. Within the Lower Klamath watershed, the Salmon River remains the most pristine tributary (Moyle 2004). Spring Chinook require deep pools for summer holding adults, such as those in the Salmon River.

In the Klamath River drainage above the Trinity, only the (Spring Chinook) population in the Salmon River and Wooley Creek remains; it has annual runs of 150-1500 fish (Campbell and Moyle 1991, Barnhart 1994). Numbers of fish in the area continue to decline (Moyle 2002) with only 90 returning adults counted in the 2005 cooperative snorkel surveys on the Salmon River (ATTACHMENT # 3 - Salmon River Spring Chinook Census Data). Approximately 177 km of habitat is accessible to spring Chinook in the Salmon River (West 1991) with a large portion being underutilized or unsuitable. Spring run Chinook are listed by the US Forest Service as a Sensitive Species in the Klamath National Forest. Reconnecting historic habitats in the Klamath and its tributaries is necessary for long term persistence of these fish (Moyle 2008).

In addition, we are sending you attached files, which are 3 zipped files

that have 1individual file. These are submitted as part of our scoping comments. We have attached one unsipped and one zipped file folder to this email. We are sending you 2 subsequent zip files in 2 subsequent emails. We have done this, as these files may be too large to be sent in one email.
These ATTACHMENTS 1,2,3,4 - A and B, 5, AND 6 are included for you to use in the development of the new regulation in the CDFG Suction Dredge Permitting Program. The emphasis of the data and information that we are providing to you is primarily related to the anadromous fisheries species of the Salmon River, highlighting spring-run Chinook, as they are unique to the Salmon River and should receive specific measures to adeqautely protect them. The files attached include: 1) ATTACHMENT # 1 – Salmon River Community Restoration Program Overview; 2) ATTACHMENT # 2 – Klamath River Basin Spring-run Chinook Map of Historic and Current Range; 3) ATTACHMENT # 3 - Salmon
River Adult Spring Chinook Survey Data 1980-2009; 4)ATTACHMENTS # 4 – A)Salmon River spring Chinook fry report [2].pdf and B) Salmon River Spring Chinook Otolith Report Draft.doc; 5) ATTACHMENT # 5 – Salmon River Spring-run Chinook Adult Spawning Survey Map; and 6) ATTACHMENT # 6 – Periodicity with Hardy, which identifies various life history of fish species in the Klamath River Basin.

Through the development and use of fisheries and watershed planning documents, the SRRC and its partners have and will continue to work closely with the Department to develop and implement actions to assist in our understanding of the Salmon River fisheries resources and to help guide the protection and recovery of these fish species, emphasizing the Spring-run Chinook.

We request that new suction dredge gold mining regulations have adequate measures in them to protect spring-run Chinook and the critical habitat needed for the recovery of this sensitive species in the Salmon River and Klamath River Basin. In addition, the new regulation should also provide adequate protection measures for the other native species of fish found in the Salmon River, as well as for the aquatic ecosystem in general.

We are available to assist the Department, as is needed and appropriate, in any additional research and data collection activities on the Salmon River related to the development of the Department's new regulations for suction dredge gold mining in the Salmon River and the Klamath River Basin

We look forward to assisting you in the development of the Department's regulations for suction dredge gold mining. Please let us know if you have any question for us or would like additional information, related to the conditions and needs in the Salmon River or other areas related to the aquatic ecosystem of the Klamath River Basin, including the Trinity River tributary.

Respectfully,

Petey Brucker – President

Overview of the Salmon River Restoration Council's Salmon River Community Restoration Program (CRP) 1992-2009

The Salmon River Restoration Council (SRRC) was formed in 1992 and was provided support by the Klamath Basin Fisheries Task Force between 1993 - 2006. The SRRC has served as the lead entity in the Salmon River subbasin in the effort to enlist cooperation amongst the stakeholders to create a watershed restoration program, highlighting the anadromous fisheries resources. The SRRC's efforts were spawned by a successful Poaching Prevention Program, which was embraced by the local community starting in 1992, and highlighted the protection of spring-run Chinook and summer steelhead. The SRRC, through its educational approach, has been recognized as reducing the poaching of these species in the Salmon River by over 90%.

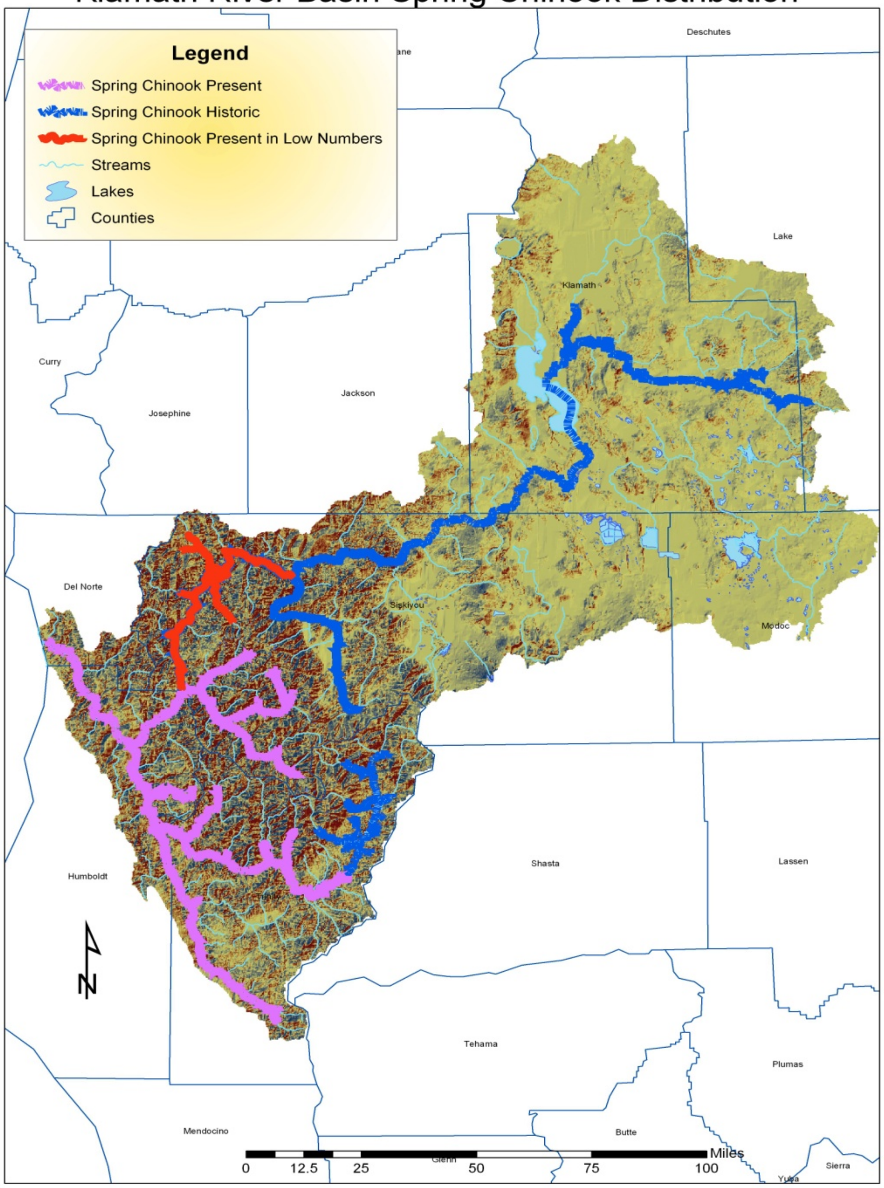
The SRRC initiated the Community Restoration Program (CRP) in 1993. Through the CRP, the SRRC has planned and sponsored an annual series of ecosystem awareness workshops to increase stakeholder awareness for the Salmon River conditions and needs. These workshops are often accompanied by volunteer workdays, which provide the opportunity for stakeholders to apply learned restoration techniques needed to promote salmonid species recovery. Through the CRP, the SRRC has held over 1,000 scheduled workshops and/or workdays that have involved over 100,000 hours of in-kind contribution, largely from the local community members. Since 1993, the SRRC has administered over $5,000,000 in fisheries/wateshed restoration activities in the Salmon River, with almost $ 2 million provided by the SRRC as in-kind contribution.

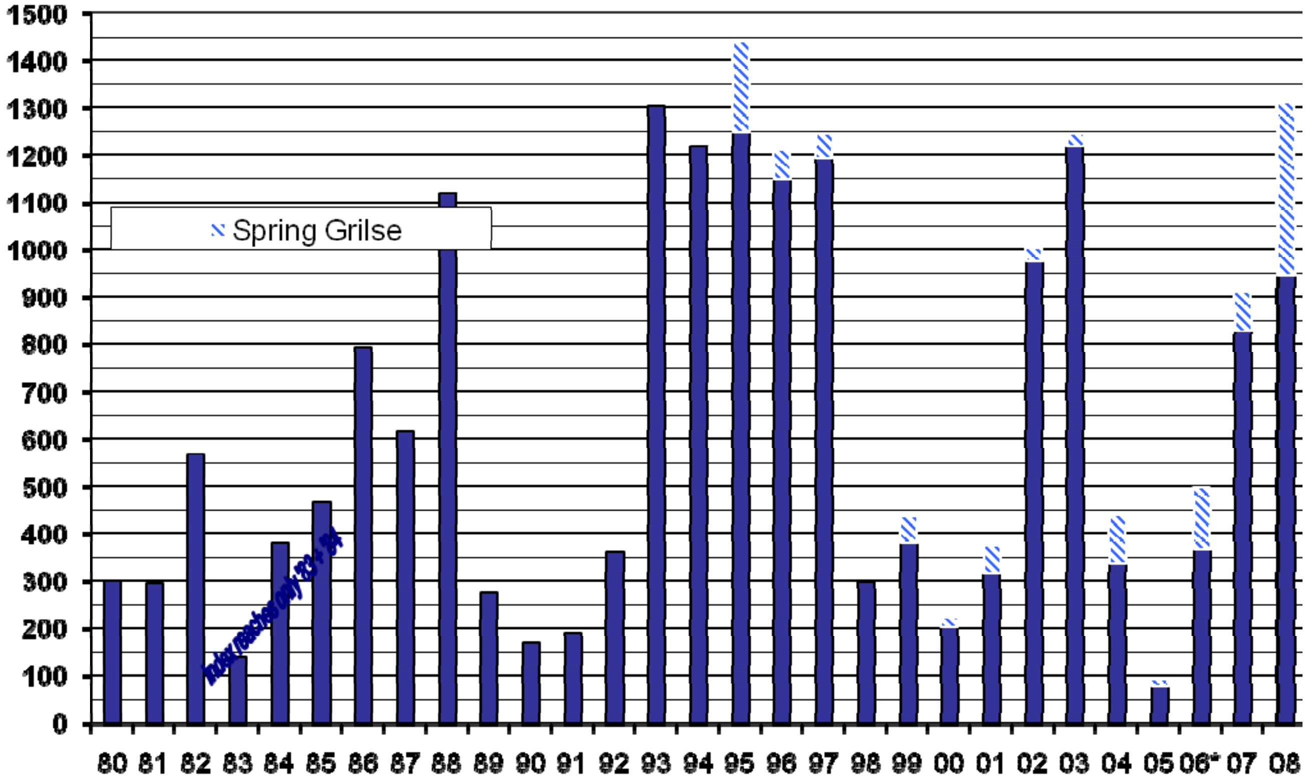
In 1994 the SRRC adopted its first annual Work Plan for the Community Restoration Program, which created an overview of conditions and needs for anadromous fisheries in the Salmon River and identified projects for the community to address these needs. The annually updated and adopted CRP Plan has helped to guide efforts for the community to help address factors that limit Salmon River salmonids.

In 2002 the SRRC and the US Forest Service completed the Salmon River Subbasin Restoration Strategy (Strategy), which assessed the anadromous fisheries resource conditions for the Salmon River and developed an "Action Matrix" to best address the limiting factors for the existing species. The SRRC and its partners utilize this Strategy, which incorporates the CRP Plan, and tiers to the Klamath and Six Rivers Land and Resource Management Plans, adopted by the US Forest Service in 2005. The SRRC assisted in the North Coast Regional Quality Control Board's (Board) TMDL process for water temperature in the Salmon River. This assessment was completed in 2005. The Board adopted the Strategy as the Salmon River TMDL Implementation Plan.

The SRRC and its partners have utilized the Strategy to guide prioritized watershed restoration and fisheries protection in the Salmon River. To address the multiple needs of salmonids, the SRRC has created nine Programs to help focus cooperator attention on specific areas. Each year the Program Coordinators develop annual work plans that are used to coordinate with our cooperators. The Program Areas include: Fisheries Monitoring and Management; Watershed Monitoring; Watershed Education; Roads Management; Fire, Fuels, and Forestry; Invasive Species Control; Riparian Habitat Assessment and Restoration; River-Clean Up; and Maintaining the Watershed Center.

Klamath River Basin Spring Chinook Distribution





Salmon River Spring Chinook Population Totals 1980-2008
*06 Estimation due to inability to survey 35% the river because of wildfires

2009 Results: Adult Spring Chinook = 527; Spring Chinook Jacks/Grilse = 116;
TOTAL – 643 returning adults for 2009

From: Peter Brucker <ptb92day@gmail.com>
To: <dfgsuctiondredge@dfg.ca.gov>
Date: 12/3/2009 5:09 PM
Subject: SRRC Suction Dredge Permit Program EIR - 2nd Installment of Zipped Files
Attachments: ATT.5.Salmon River Spring run Chinook REDD data..03-06.zip; ATT.4.A.SalmonRiverspringChinookfryreport[2].zip

Mark,

Here is the SRRC's 2nd installment of zipped files.

Petey Brucker - SRRC President

From: Peter Brucker <ptb92day@gmail.com>
To: <dfgsuctiondredge@dfg.ca.gov>
Date: 12/3/2009 5:28 PM
Subject: SRRC Suction Dredge Permit Program EIR - 3rd Installment of Zipped Files
Attachments: ATT.4.B.SalmonRiverspringChinookfryreport[2] (2).zip

Abstract

SRRC Suction Dredge Permit Program EIR - 3rd Installment of Zipped Files

Mark,

Here is the SRRC's 3rd installment of zipped files.

Petey Brucker - SRRC President

Overview of the Salmon River Restoration Council's Salmon River Community Restoration Program (CRP) 1992-2009

The Salmon River Restoration Council (SRRC) was formed in 1992 and was provided support by the Klamath Basin Fisheries Task Force between 1993 - 2006. The SRRC has served as the lead entity in the Salmon River subbasin in the effort to enlist cooperation amongst the stakeholders to create a watershed restoration program, highlighting the anadromous fisheries resources. The SRRC's efforts were spawned by a successful Poaching Prevention Program, which was embraced by the local community starting in 1992, and highlighted the protection of spring-run Chinook and summer steelhead. The SRRC, through its educational approach, has been recognized as reducing the poaching of these species in the Salmon River by over 90%.

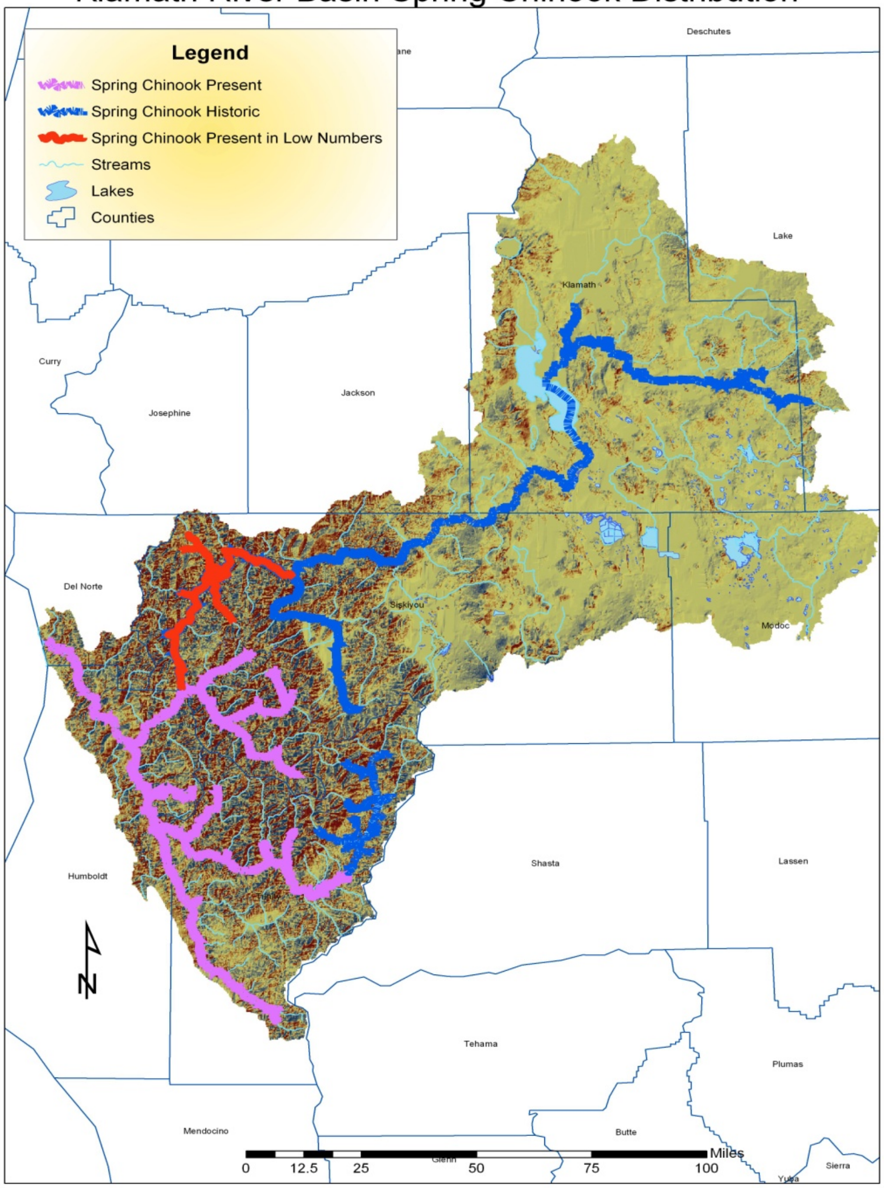
The SRRC initiated the Community Restoration Program (CRP) in 1993. Through the CRP, the SRRC has planned and sponsored an annual series of ecosystem awareness workshops to increase stakeholder awareness for the Salmon River conditions and needs. These workshops are often accompanied by volunteer workdays, which provide the opportunity for stakeholders to apply learned restoration techniques needed to promote salmonid species recovery. Through the CRP, the SRRC has held over 1,000 scheduled workshops and/or workdays that have involved over 100,000 hours of in-kind contribution, largely from the local community members. Since 1993, the SRRC has administered over $5,000,000 in fisheries/wateshed restoration activities in the Salmon River, with almost $ 2 million provided by the SRRC as in-kind contribution.

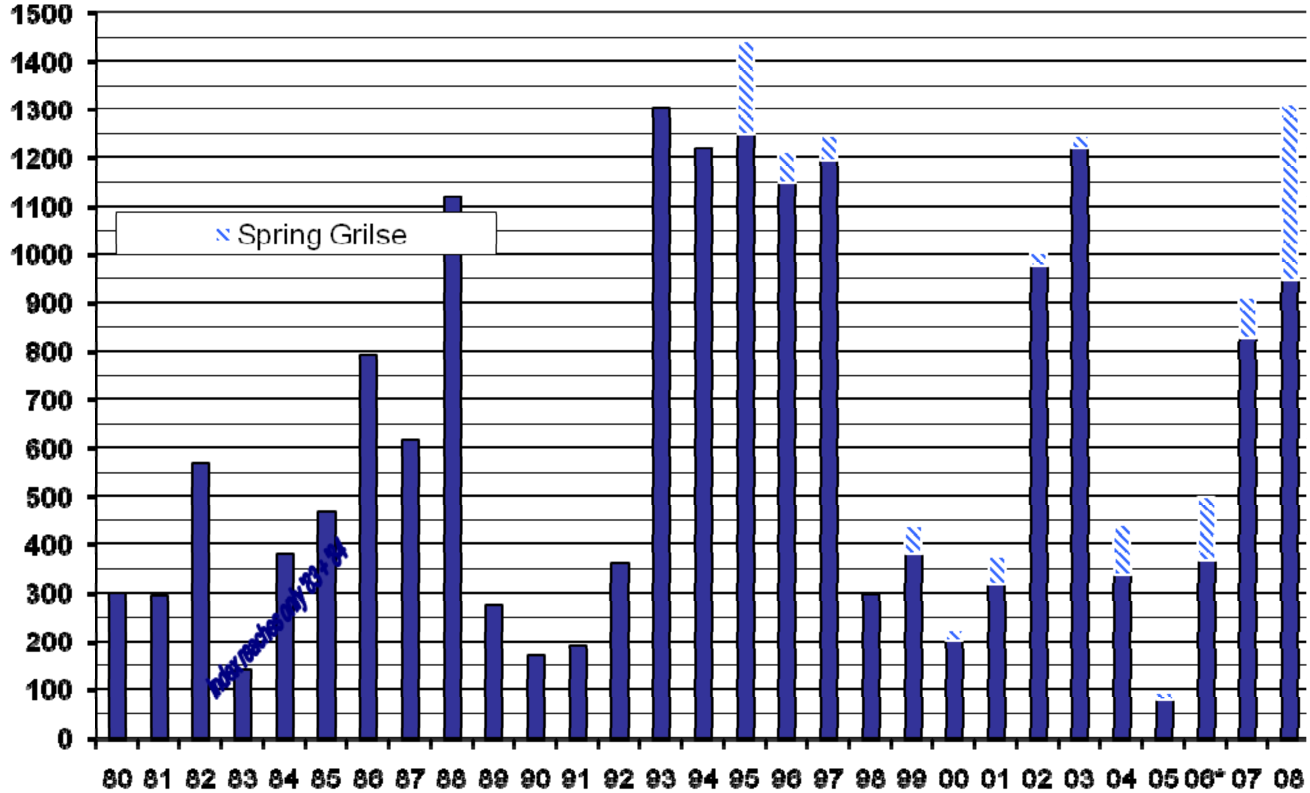
In 1994 the SRRC adopted its first annual Work Plan for the Community Restoration Program, which created an overview of conditions and needs for anadromous fisheries in the Salmon River and identified projects for the community to address these needs. The annually updated and adopted CRP Plan has helped to guide efforts for the community to help address factors that limit Salmon River salmonids.

In 2002 the SRRC and the US Forest Service completed the Salmon River Subbasin Restoration Strategy (Strategy), which assessed the anadromous fisheries resource conditions for the Salmon River and developed an "Action Matrix" to best address the limiting factors for the existing species. The SRRC and its partners utilize this Strategy, which incorporates the CRP Plan, and tiers to the Klamath and Six Rivers Land and Resource Management Plans, adopted by the US Forest Service in 2005. The SRRC assisted in the North Coast Regional Quality Control Board's (Board) TMDL process for water temperature in the Salmon River. This assessment was completed in 2005. The Board adopted the Strategy as the Salmon River TMDL Implementation Plan.

The SRRC and its partners have utilized the Strategy to guide prioritized watershed restoration and fisheries protection in the Salmon River. To address the multiple needs of salmonids, the SRRC has created nine Programs to help focus cooperator attention on specific areas. Each year the Program Coordinators develop annual work plans that are used to coordinate with our cooperators. The Program Areas include: Fisheries Monitoring and Management; Watershed Monitoring; Watershed Education; Roads Management; Fire, Fuels, and Forestry; Invasive Species Control; Riparian Habitat Assessment and Restoration; River-Clean Up; and Maintaining the Watershed Center.

Klamath River Basin Spring Chinook Distribution



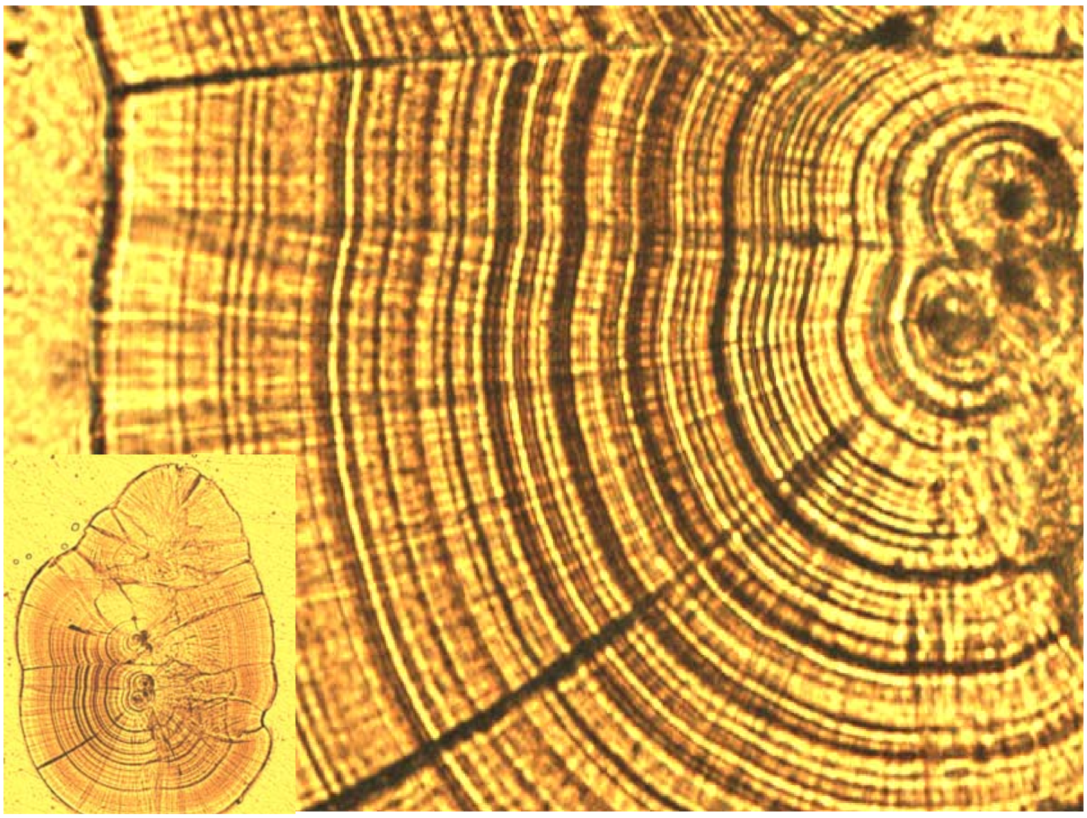


Salmon River Spring Chinook Population Totals 1980-2008
*06 Estimation due to inability to survey 35% the river because of wildfires

2009 Results: Adult Spring Chinook = 527; Spring Chinook Jacks/Grilse = 116;
TOTAL – 643 returning adults for 2009

Arcata Fisheries Technical Report AFWO-TR01-05

Microstructural Natal Signature of Spring Chinook Salmon Otoliths from the Salmon River Drainage, Northern California



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March 2005

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Microstructural Natal Signature of Spring Chinook Salmon Otoliths from the Salmon River Drainage, Northern California

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Abstract. Early life history events in juvenile salmonid development, including eye-up, hatch, emergence, and habitat transitioning, can be linked to otolith microstructural patterns. In recent years, the combination of early life history events and incubation thermal regime has been used to associate stocks with specific incubation sites. Variation in temperature and growth can produce otolith increment patterns that are stock specific, provided the stock incubated under a distinct thermal regime. The resulting otolith increment pattern may be specific to the thermal regime under which embryonic and alevin development occurred, as it is generally accepted that increment deposition occurs prior to hatch. In this study, otoliths were collected from spring Chinook salmon (*Oncorhynchus tshawytscha*) fry captured from spawning sites on the North and South forks of the Salmon River in northwestern California in spring 2004. Otolith microstructure was analyzed using light microscopy and imaging software and later compared between the two forks and to other samples collected previously in the Klamath Basin. A natal microstructural signature was present on all otoliths collected in the Salmon River Basin (n=91) that was distinctive from other Klamath Basin collections. Natal signatures of fish collected from the North and South forks of the Salmon River were similar, indicating that both sample sites may have comparable thermal regimes during the incubation and intragravel development period for spring Chinook salmon.

Introduction

Otolith microstructure analysis has been used to determine age and growth of individual fish for many years. Recently, otolith microstructural patterns have been used to identify different juvenile life history types or life history events (e.g. Neilson et al. 1985; Larsen and Reisenbichler 1993, Volk et al. 1995) and to differentiate stocks in a system (e.g. Paragamian et al. 1992, Rieman and Myers 1994, Quinn et al. 1999). Transitions in life history such as “eye-up”, hatch, emergence, and migration from one habitat to another (e.g. freshwater to saltwater) are recorded in microstructural patterns of otoliths. These changes appear as variations in increment deposition on otoliths that alter appearance of the microstructural pattern (Marshall and Parker 1982; Campana and Neilson 1985; Volk et al. 1990, 1996).

Fish otoliths are comprised primarily of calcium carbonate in aragonite mineral form embedded in a collagen-like organic matrix (Degens et al. 1969). Organic and inorganic components of otoliths interact during otolith growth to lay down a series of dark and light bands that reflect the bipartite nature of otolith increments. Incremental patterns may be comprised of a few to many individual increments that reflect previously mentioned life history events or changes in environment such as temperature or salinity.

Variation in temperature and growth can produce otolith increment patterns that are stock specific, provided the stock incubated under a distinctive thermal regime (Zhang et al. 1995, Volk et al. 1996, Quinn et al. 1999). The resulting increment pattern is specific to the thermal regime under which embryonic and alevin development occurred as it is generally accepted that increment deposition initiates prior to hatching (Quinn et al. 1999). The portion of the incremental pattern that exemplifies natal origin is located near the core of the otolith and represents intragravel residency. In this study, the core region of otoliths is referenced as the "developmental check region", encompassing the area between and including the hatch and emergence checkmarks.

The primary objective of this study was to identify a developmental check region and associated microstructural pattern of newly emerged spring Chinook salmon (*Oncorhynchus tshawytscha*) from the North and South forks of the Salmon River through qualitative and quantitative means. Identification of this region and its associated incremental pattern should reflect a natal signature of collection sites. A secondary objective, dependent on the ability to identify a developmental check pattern (objective 1), was to compare the developmental check patterns from samples collected from the North and South forks of the Salmon River to each other; as well as to visually compare the patterns to other recognized patterns.

Study Area

Otoliths were collected from spawning sites on the North and South forks of the Salmon River, located in the Salmon River watershed of the Klamath River Basin in northwestern California (Figure 1). Sample sites were chosen based on knowledge of spring Chinook spawning exclusivity above the two forks of Salmon River (Peter Brucker, Salmon River Restoration Council, personal communication). Sample sites were similar in elevation and hydrology. Spring run Chinook salmon spawn from about mid-September to late October above the forks of the Salmon River (Table 1), whereas fall run Chinook salmon spawn later in the year in the mainstem Salmon River below the forks. Spring Chinook salmon fry incubate and emerge from redds in January to May (Table 1). Otoliths were collected from fish captured directly below Idlewild Campground (elevation ~783 m) on the North Fork Salmon River and about 1.6 km below Blind Horse Creek (elevation ~823 m) on South Fork Salmon River (Figure 1).

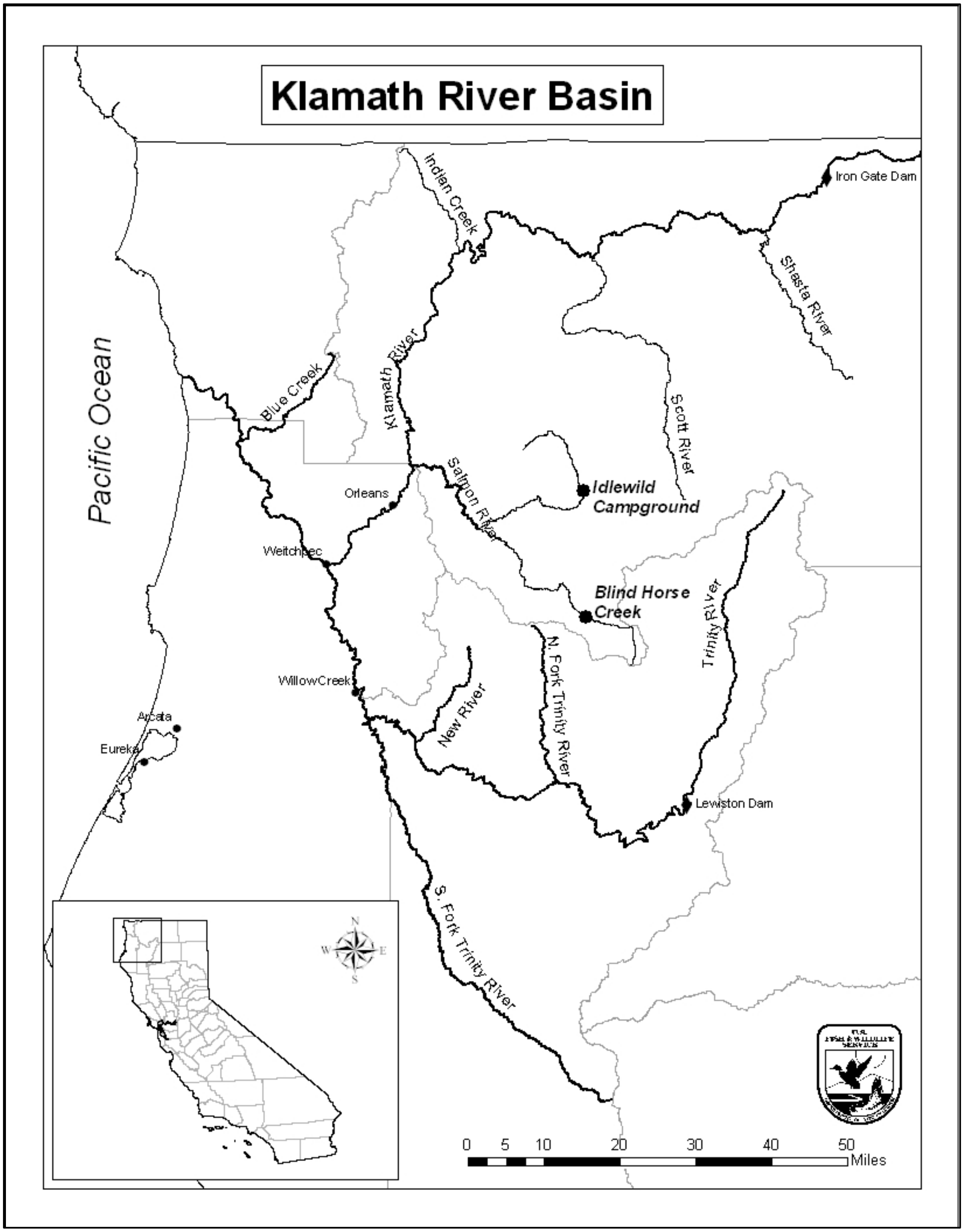

Figure 1. Map of Salmon River showing collection sites.

Table 1. Salmon River Chinook salmon early life stage periodicity (courtesy of Karuk Tribal Fisheries Program).

		Month											
Life Stage	Run	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Redd construction	Spr									X	X		
	Fall										X	X	
Egg incubation and fry emergence	Spr	X	X	X	X	X							
	Fall	X	X	X	X	X							
Fry rearing (up to 50mm)	Spr				X	X	X	X					
	Fall				X	X	X	X					

Methods

Spring Chinook salmon fry were captured from Idlewild Campground and Blind Horse Creek spawning areas using an 18.5 x 14.5 cm dipnet having a mesh size of about 1 mm. A targeted sample size of about 70 spring Chinook salmon fry from each fork of Salmon River was established prior to field collection. Sample size was based on three criteria: (1) type of study (i.e. lethal or non-lethal), (2) life stage of the fish, (3) adequate numbers to establish variance and reliability, and (4) experience of researcher (UFR Committee 2004). Fish fork lengths were measured to nearest millimeter (mm) before fish were frozen prior to laboratory preparation. Otoliths were removed, prepared, and analyzed in the Otolith Laboratory of the Arcata Fish and Wildlife Office in Arcata, California. Otoliths were extracted, cleaned of membranous tissue, and allowed to dry before length (nearest 0.1mm) and weight (nearest 0.00001g) were measured. Extracted otoliths were then embedded in a resin block that was lapped on both sides until the primordial region of the otolith core was exposed. This procedure allowed the pre-and post-hatch area incremental patterns to be viewed by light microscopy.

Prepared samples were visually examined for incremental patterns and “checkmarks” in the region between the core and edge of the otolith. A particular checkmark associated with hatching was noted. ‘Hatch checkmarks’ of salmonids usually appear in the form of a very dark band or structural discontinuity from previous increments. An ‘emergence checkmark’ occurs prior to a transitional area from broad or indistinct increments of the post-hatch alevin to the well-defined daily incremental banding of emergent fry (Volk et al. 1995). For the purpose of this study, a developmental check was defined as a region of increments located between a hatch check and an emergence check, including the two checks. The natal signature was defined as the increments located between the otolith core to the end of the developmental check region since increment deposition in this region occur during intragravel development.

Descriptions of visually examined incremental patterns of specific otolith regions were noted and recorded for each sample. Analyzed otolith regions included the following areas: (1) core to beginning of developmental check, (2) developmental check, and (3) end of developmental check to otolith edge. These areas are referred to as 'regions' for the purpose of this study. All samples were visually analyzed twice with a lapse of three weeks between analyses to avoid reader bias as the same reader conducted both analyses.

Quantitative analyses of otolith regions were completed using light microscopy, an image analysis software system, and a statistical software package. Linear distances of radii (core to specific checkmarks and to otolith edge), incremental widths, and distances between specific checks (hatch and emergence) were measured, recorded, and entered into a database.

Determination of significant difference between developmental check regions of the North and South forks of Salmon River was established using an independent *t*-test (Murphy and Willis 1996), as shown by the equation:

$$t = (\bar{y}_1 - \bar{y}_2)\sqrt{\frac{n_1 n_2}{n_1 + n_2}} \Big/ \sqrt{\frac{(n_1 - 1)s_1^{\,2} + (n_2 - 1)s_2^{\,2}}{n_1 + n_2 - 2}}$$

Where t = Test of significant difference between two sample means, $\bar{y}$ = sample means, s^2 = sample variances, and n = sample sizes.

Results

Collection of spring Chinook salmon fry at Idlewild Campground (North Fork) was completed on two separate dates because sampling on the first date of March 25, 2004, resulted in a total of five samples. A second visit to the campground on April 6 yielded 28 additional samples. Collection of fish near Blind Horse Creek on the South Fork of the Salmon River yielded 74 samples on March 5, 2004. Mean fork lengths of North Fork and South Fork samples were 36.3 and 35.8 mm, respectively (Appendix A).

Of the 107 samples collected (North Fork=33, South Fork=74), only 91 samples (North Fork=28, South Fork=63) were used in the visual and quantitative analysis. Sixteen samples were not used due to one or more of the following circumstances: unacceptable radial angle, abnormal crystalline formation on otolith, uneven microstructural growth patterns along radial angle, loss of otolith (part or whole), and/or poor sample preparation.

Visual analysis of North Fork and South Fork samples resulted in a consistently identifiable developmental check pattern located in the same region of the otoliths. Both sample groups exhibited a developmental check pattern that began with a hatch check composed of two dark bands separated by one light band and ending with an emergence check composed of three dark bands separated by two light bands (Figure 2). These distinctive increment pattern segments of the developmental check were apparent for all samples, even as deposition of increments varied in color intensity (Figure 3). The only subtle difference observed was a color intensity change of a few increments (about 2-4) in the area directly preceding the hatch checkmark sequence on the North Fork samples (Figure 2). This small number of increments did not appear larger or smaller in width

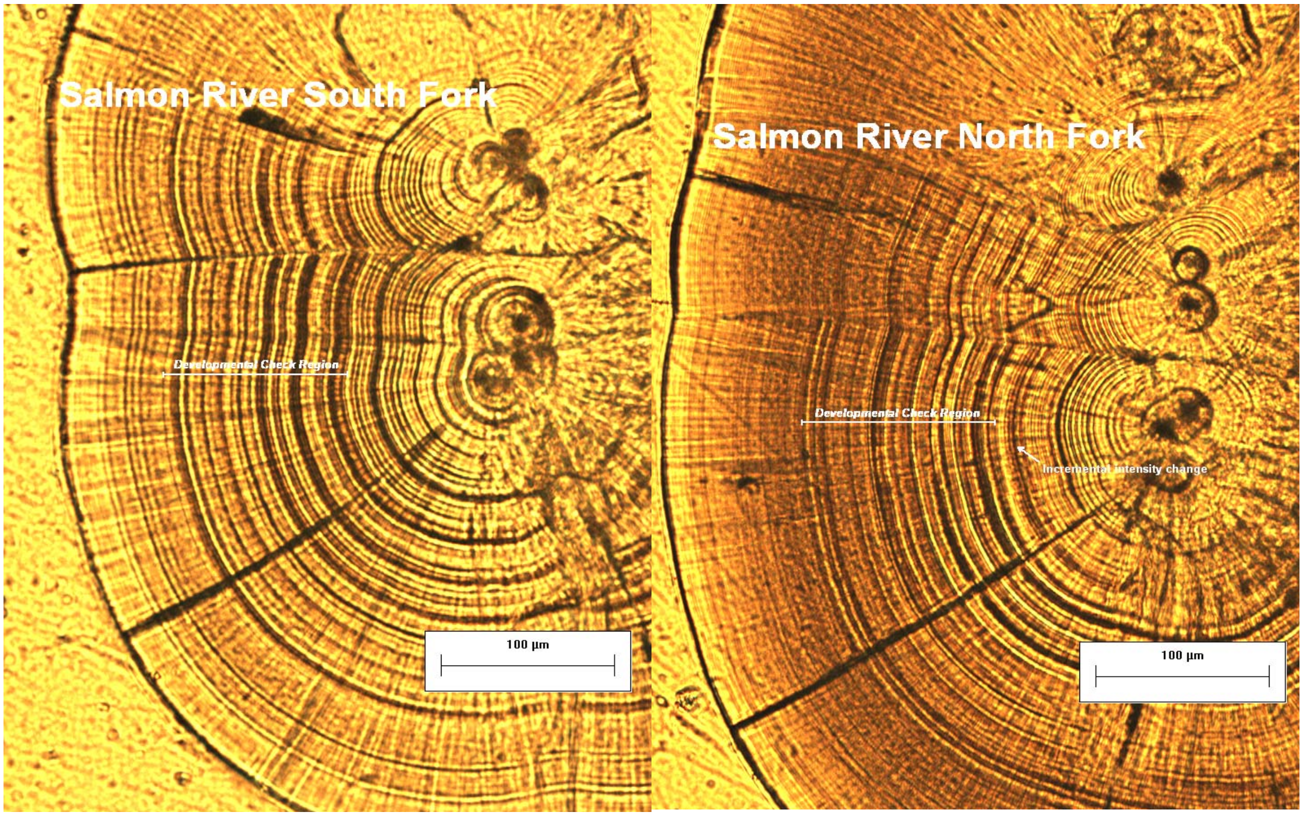

Figure 2. Photographs of representative otoliths from spring Chinook salmon fry collected from the North and South forks of the Salmon River, Klamath River Basin, northwestern California in 2004. Note the similar ‘developmental check’ regions.

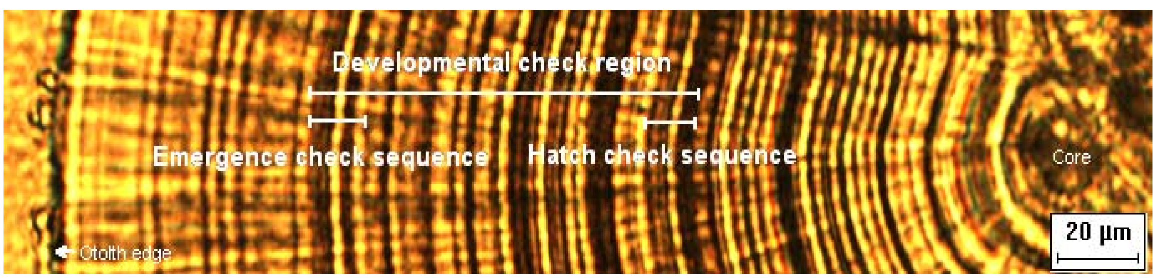

Figure 3. Developmental check sequence on an otolith extracted from a spring Chinook salmon fry collected in the Salmon River drainage in the Klamath River Basin, northwestern California in 2004.

from other increments prior to the change of intensity and did not yield a transitional appearance of increments beyond this point as would a hatch check.

Based on this subtle visual differentiation of the North Fork Salmon River samples and the South Fork Salmon River samples, a blind examination of 30 mixed samples was conducted. This test resulted in 26 samples or 86% correctly identified to associated collection site (Appendix B).

The developmental check width and linear distance from the core region did not differ significantly (p=0.7 and 0.1 at $\alpha = 0.05$, respectively) between the two sample groups

Table 2. Summary of a two sample t-test ($\alpha = 0.05$. df=89) comparing mean linear widths of specific otolith regions between spring Chinook salmon collected on the North and South forks of the Salmon River in 2004.

		Core to Developmental Check Region					Developmental Check Region					Post Developmental Check Region				
Site	n	Mean (µm)	SD (µm)	SE (µm)	t value	p value	Mean (µm)	SD (µm)	SE (µm)	t value	p value	Mean (µm)	SD (µm)	SE (µm)	t value	p value
North Fork	28	98.8	15.5	2.9			88.6	1.7	0.3			72.1	11.6	2.2		
					-1.6	0.1				-0.4	0.7				11.1	0.0
South Fork	63	103.2	10.4	1.3			88.7	1.4	0.2			44.0	11.0	1.4		

(Table 2). Mean widths of the developmental check region for the North Fork Salmon River samples (mean =88.6, s=1.7, n=28) and the South Fork Salmon River samples (mean =88.7, s=1.4, n=63) were similar (t=-0.4, df=89, p=0.7) (Table 2). Mean distance of developmental check from core area for North Fork Salmon River samples (mean =98.8, s=15.5, n=28) and the South Fork Salmon River samples (mean =103.2, s=10.4, n=63) were also similar (t=-1.6, df=89, p=0.1) (Appendix C). The developmental check region contained similar increment counts with a mean of 27 increments (s=1.9, n=28) for the North Fork Salmon River group and a mean of 28 increments (s=2.0, n=63) for the South Fork Salmon River group (t=-1.4, df=89, p=0.2) (Table 3) (Figure 4).

Mean width of post-developmental check area for North Fork Salmon River samples (mean=72.06, s=11.59, n=28) and South Fork Salmon River samples (mean=43.99, s=10.98, n=63) were found to be significantly different (t=11.06, df=89, p<0.001) (Table 2). This difference is a direct result of the number of increments within this region for each sample group. Spring Chinook salmon fry from the North Fork had an average of 18 increments post emergence, which differed significantly from South Fork samples that had an average of 29 increments for the same region (t=11.13, df=89, p<0.001) (Table 3).

Table 3. Summary of a two sample t-test ($\alpha = 0.05$. df=89) comparing mean increment counts of specific otolith regions between spring Chinook salmon collected on the North and South forks of the Salmon River in 2004.

		Core to Developmental Check Region					Developmental Check Region					Post Developmental Check Region				
Site	n	Mean	SD	SE	t value	p value	Mean	SD	SE	t value	p value	Mean	SD	SE	t value	p value
North Fork	28	15	3.5	0.7			27	1.9	0.4			29	4.4	0.8		
					-2.7	0.0				-1.4	0.2				11.1	0.0
South Fork	63	17	2.5	0.3			28	2.0	0.3			18	4.2	0.5		

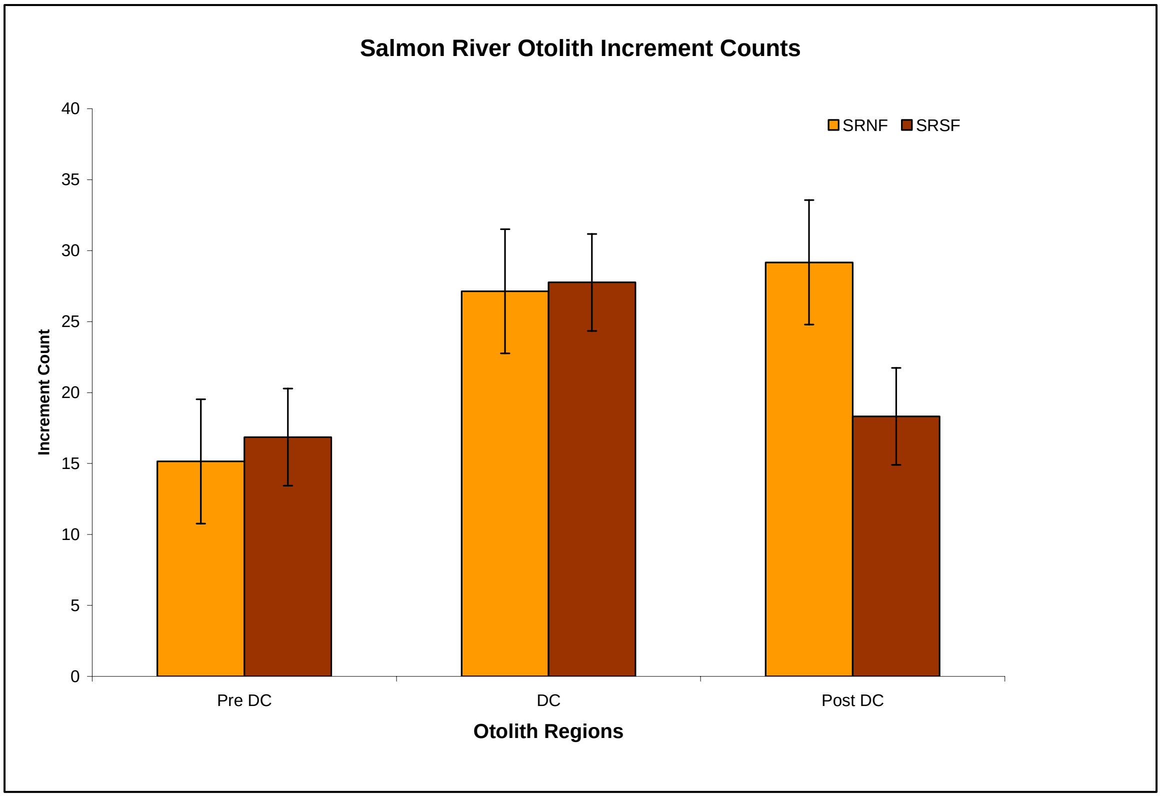

Figure 4. Mean incremental counts of otolith regions from spring Chinook salmon fry collected from North (SRNF) and South (SRSF) forks of the Salmon River in 2004. Vertical lines represent standard error at 95% confidence interval (DC = developmental check).

Discussion

Otoliths collected from Salmon River spring Chinook salmon fry exhibited a particular pattern of contrasting variation in incremental definition of the pre- and post-hatch regions regardless of sampling site. This particular increment pattern was consistently apparent even when sample quality was flawed indicating similar incubational thermal regimes between the Salmon River sampling sites.

Visual examination of otoliths from the North and South forks of the Salmon River indicated that spring Chinook salmon fry incubated under similar thermal regimes. Both groups exhibited the same hatch check incremental sequence and the same emergence check incremental sequence with some variation of increment deposition between the two checks. The only visual difference between the two groups was that the North Fork samples had a few increments that appeared visibly darker prior to the developmental check region than the South Fork samples. Unfortunately, overwintering water temperature data were not available; only temperatures at the time of the collections were recorded by field crews. Water temperature at North Fork sample site was 8°C on April 6, 2004, and 9°C at the South Fork sample site on March 5, 2004. Although a blind test on this subtle difference yielded an 86% correct pattern: site identification ratio, the test was time consuming, even when conducted by a proficient reader and should be performed with care. If time and/or reader experience is a concern, genetic analyses may provide a more efficient means to assess stock origin, assuming spring Chinook salmon in the North and South forks of the Salmon River differ genetically.

Comparative visual analysis of the Salmon River developmental checkmark was distinct from microstructural patterns associated with Chinook salmon from the Iron Gate hatchery, Trinity River hatchery, and samples collected from the upper Trinity River mainstem (Figures 5-7). This visual difference suggests that the developmental thermal regimes varied between collection sites.

Linear measurements across the developmental check pattern and distance of the developmental check region from the core area did not differ between the North and South forks of the Salmon River. However, there was a significant difference ($p<0.001$) in the width of the post-emergence region of otoliths between the two streams. The mean width of the post-emergence region from otoliths collected on the North Fork was 72.06 µm compared to 43.99 µm for the South Fork samples. As expected, a larger area encompasses a greater number of increments. This is important as teleost fish otoliths deposit increments with a daily periodicity (Campana 1992). More increments beyond the emergence check constitutes more post-emergent days at liberty. The North Fork Salmon River group contained an average of 29 increments within this region, whereas the South Fork Salmon River group contained an average of 18 increments within this region (Figure4). Date of collection appears to support the theory of increment depositional rate

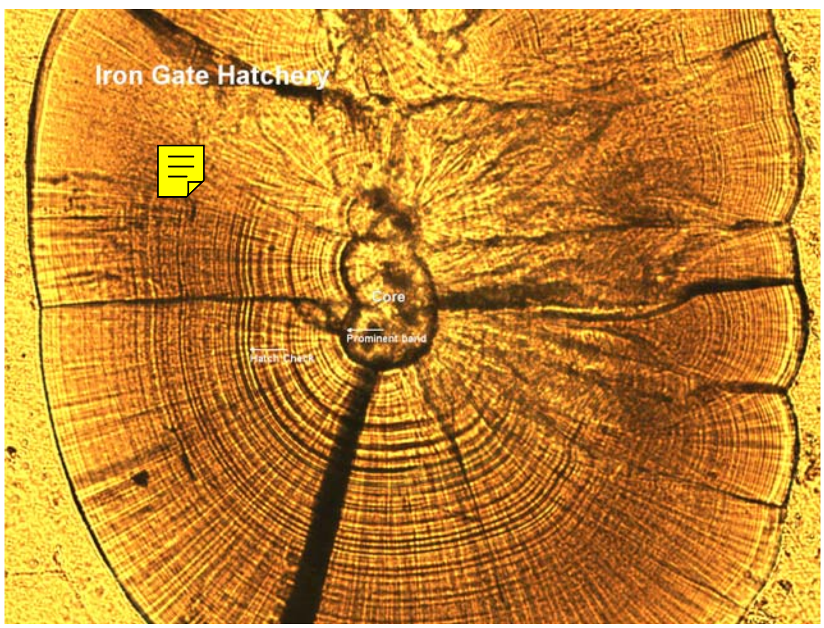

Figure 5. Photograph of otolith microstructural pattern representative of fall Chinook Salmon from Iron Gate Hatchery located in Siskiyou County, California. Note the prominent band surrounding the core region which differentiates this particular pattern from other Klamath Basin patterns sampled thus far.

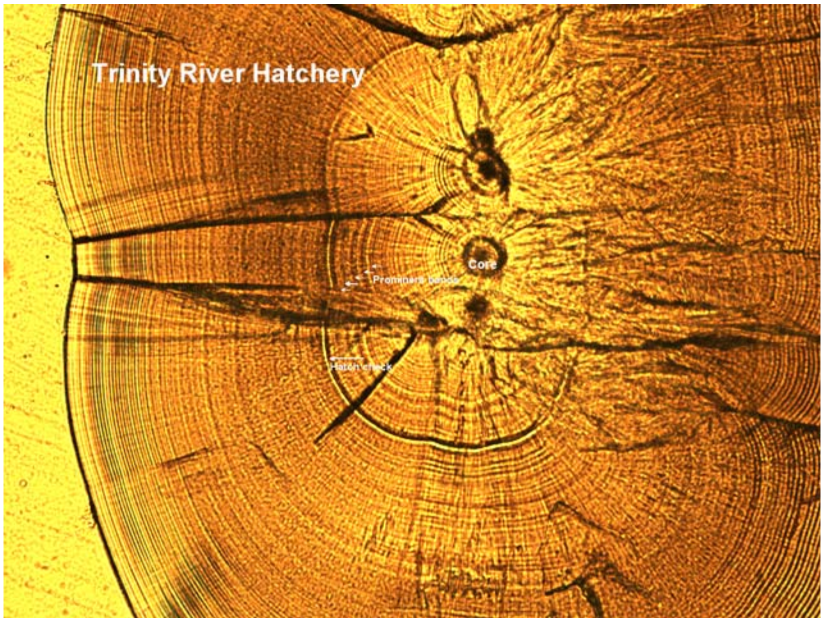

Figure 6. Photograph of otolith microstructural pattern representative of fall Chinook salmon from the Trinity River Hatchery located in Trinity County, California. Note the five prominent bands occurring prior to hatch check. This banding pattern differentiates this particular pattern from other Klamath Basin patterns sampled thus far.

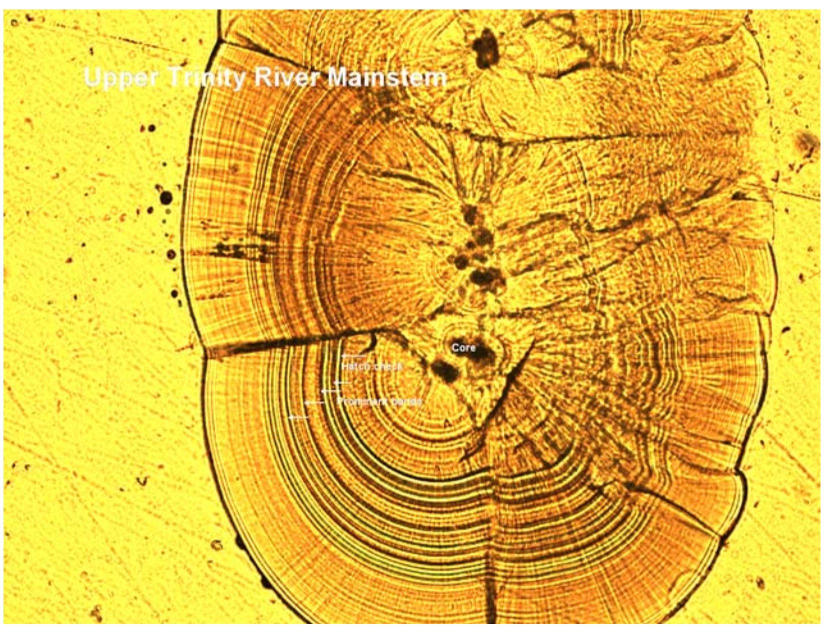

Figure 7. Photograph of an otolith microstructural pattern of a Chinook salmon sampled from upper Trinity River mainstem located in Trinity County, California. Note the four prominent bands post hatch check.

as the North Fork was sampled near the end of March 2004 and again in early April 2004. South Fork was sampled in early March 2004.

This study identified a distinct microstructural pattern in spring Chinook salmon spawned in 2003 in the North and South forks of the Salmon River that differed from patterns documented for other collections in the Klamath Basin. However, results of this study are limited due to small sample sizes, sample size inequality, and its reliance on a single brood year, stream, and race. Additional studies are needed to clarify the specific natal microstructural signature of spring Chinook salmon stocks in the Salmon River, including: (1) otolith study of spring Chinook salmon adults returning to the Salmon River, (2) continuing the otolith study of spring Chinook salmon fry in the Salmon River drainage with increased sample sizes and collection of overwintering water temperatures, (3) a comparative study between fall and spring Chinook salmon fry otoliths in the Salmon River drainage, and (4) a comparative study of spring Chinook salmon fry otolith microstructure from the Salmon River to microstructure of other river systems outside the Klamath Basin.

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Appendices

Appendix A Summary of two sample t-test ($\alpha = 0.05$; df=89) used to compare mean fork lengths of spring Chinook salmon collected on the North and South forks of the Salmon River in spring 2004.

Site	n	Mean (mm)	SD (mm)	SE (mm)	t value	p value
North Fork Salmon River	28	36.3	1.8	0.4	1.0	0.3
South Fork Salmon River	63	35.8	2.0	0.3		

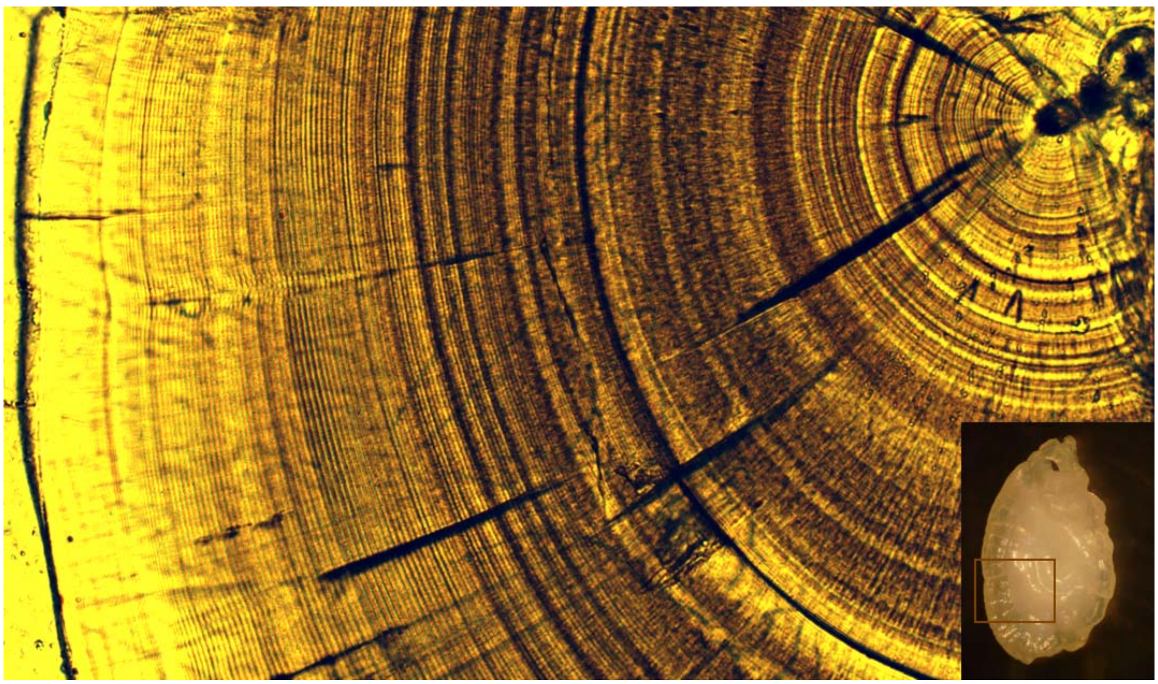
Appendix B. Summary of the developmental check blind test of spring Chinook salmon fry samples from the North (NF) and South(SF) forks of the Salmon River mixed. .

Sample #	NF	SF	Correct?	Comments
1		X	Yes	
2		X	Yes	
3		X	Yes	
4		X	Yes	
5	X		Yes	
6		X	Yes	
7	X		Yes	
8		X	No	Poor Preparation
9	X		Yes	
10	X		Yes	
11		X	No	Poor Preparation
12		X	Yes	
13	X		No	Broken slide
14		X	Yes	
15	X		Yes	
16		X	Yes	
17	X		Yes	
18	X		Yes	
19	X		Yes	
20	X		Yes	
21	X		Yes	
22		X	Yes	
23		X	Yes	
24		X	Yes	
25	X		Yes	
26	X		Yes	
27		X	Yes	
28		X	Yes	
29		X	No	Poor Preparation
30		X	Yes	

Arcata Fisheries Technical Report XXXX DRAFT

Identification of Migratory Juvenile Spring Chinook Salmon via Rotary screw trap on the Salmon River, California

Jane C. Sartori



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*Abstract*The Salmon River, located in northwestern California, is one of the last known refuges for naturally produced Klamath basin spring Chinook salmon (*Oncorhynchus tshawytscha*). Previous salmonid distribution and abundance monitoring studies of the Salmon River determined two migration peaks; the primary occurring in spring and the secondary occurring in the fall. To determine if there was any spring Chinook salmon emigrating during the secondary peak, an otolith microstructural study was performed on left sagittal otoliths collected during the secondary peak between the years of 2003-2005.

Of the 58 otolith samples analyzed in this study, a total of 18 otoliths were identified as Salmon River spring Chinook salmon when compared to previous Salmon River juvenile spring Chinook salmon microstructural data ($p > 0.05$). The origination of the remaining 40 otolith samples remained unidentified due to absence of baseline juvenile fall Salmon River Chinook salmon microstructural data and had a different microstructural pattern from the known spring Chinook salmon microstructural pattern ($p < 0.05$).

A secondary study objective was to determine freshwater residency and associated growth rates of all Salmon River Chinook salmon otoliths analyzed in this study. Overall mean freshwater residency was estimated to be 136 days with an estimated mean growth rate of 0.23 mm/day.

Results of this study are preliminary until further studies involving known fall Salmon River Chinook salmon otolith microstructure, adult Salmon River spring and fall otolith microstructure, and genetic analyses can be investigated.

Introduction

Otolith-based research provides information on the population biology and life history of fish that is otherwise extremely difficult, if not impossible, to collect such as daily age and growth rates, hatch and emergence dates, life stage transitions, and habitat transitions (Begg *et al*. 2005). Cyclic depositions of organic and inorganic components of otoliths interact to lay down a series of sequential dark and light bands that reflect the bipartite nature of otolith increments. Unlike scales, otoliths are comprised of crystalline calcium carbonate polymorphs that are embedded in a proteinaceous matrix that, once deposited, is metabolically inert resulting in no resorption or remineralization (Gauldie and Nelson 1990).

Variation in temperature and growth can produce otolith increment patterns that are stock specific, provided the stock incubated under a distinctive thermal regime (Zhang *et al*. 1995, Volk *et al*. 1996, Quinn *et al*. 1999). The resulting increment pattern is specific to the thermal regime under which embryonic and alevin development occurred as it is generally accepted that increment deposition initiates prior to hatching (Quinn *et al*. 1999). For this study, the area of the otolith denoting the developmental life stage of the fish are the increments located between and including the hatch and emergence checks and is referenced as the 'developmental check region' (DC region).

Given that a fish length to otolith length relationship can be determined, the widths of the sequential increments located post-emergence provide daily growth rates of the fish at a specific age and on a specific date provided that increment deposition is daily (Campana and Jones 1992). Since various authors have previously demonstrated the deposition of otolith increments of Chinook salmon to be daily (Wilson and Larkin 1982, Marshall and Parker 1982, Volk *et al*. 1984, Neilson and Geen 1985; and others), this study did not investigate the increment depositional rate and assumes that increment periodicity is daily.

Abundance and distribution studies on emigrating juvenile Chinook salmon (*Oncorhynchus tshawytscha*) of the Salmon River, California, have shown two distinct migration peaks that occur in spring/early summer and in the fall (UFWS, *in prep*, Juvenile Salmonid Monitoring on the Mainstem Salmon River at Somes Bar, CA). The Salmon River supports spring- and fall-run Chinook salmon, as well as other salmonid species such as coho salmon (*O. kisutch*) and steelhead (*O. mykiss*).

The primary objective of this study was to identify and estimate the number of juvenile spring Chinook salmon emigrating from the Salmon River, CA based on screw trap collections throughout the migration season which began in spring and ended in the fall. Unfortunately, collected sample sizes were very small (< 100) and only represented the latter portion of the migration season which eliminated a comparative study between the number of emigrating juvenile spring Chinook salmon found in the primary and secondary migration peaks of the Salmon River. Due to these circumstances, a redirection in the primary objective of a comparative study between the two migration peaks became an identification and enumeration of migrating juvenile Chinook salmon that display the previously identified Salmon River spring Chinook salmon microstructural pattern (Sartori 2005) of the collected screw trap samples. Other study objectives included an estimation of freshwater residency and associated growth rates; and identification of hatch and emergence checks.

Study Area

A rotary screw trap was placed 1.5 river kilometers (rkm) upstream from the confluence of the Salmon River and the Klamath River to monitor distribution and abundance of emigrating juvenile salmonids. Trap site was chosen based on its proximity to the mouth of the Salmon River, accessibility, and a deep thalwag to situate the trap in (W. Pinnix, U.S. Fish and Wildlife Service, personal communication). Trap was checked daily throughout the season which extended from approximately April through October annually; wherein live-box mortalities from trapping efforts were salvaged during the latter part of the migration season to obtain otoliths for microstructural studies (Figure 1).

All salvaged juvenile Chinook salmon mortalities (n = 66) were immediately frozen upon collection to avoid any surface degradation of otoliths by crews from the Karuk Tribe's Natural Resources Department and those from the Salmon River Restoration Council.

Methods

Otolith preparation and analysis

Sagittal otoliths were extracted from the juvenile Chinook salmon mortalities by the 'open-the-hatch' method as described in Secor *et al.* (1991). After extraction, otoliths were cleaned and dried using ambient air temperature before obtaining their weights (nearest 0.00001 grams) and lengths (nearest 0.1 millimeters). Otoliths were then embedded separately in polyester resin before being mounted on a glass slide with thermoplastic cement. After otoliths had been mounted on glass slides, the excess resin above the surface of the otolith was cut off using a low speed saw. Otoliths were then lapped on both sides with a lapping wheel until the primordial region was exposed.

Otolith increments and checks were marked beyond the core region of the otolith to the edge of the otolith on a preferred measurement angle of 73° ($\pm$ 3º) radiating from a transect line that begins at the otolith rostrum proceeding distally through a predetermined nucleus to the otolith postrostrum (see Figure 2 for otolith diagram). Analyzed otolith regions included the following areas: 1) core to beginning of developmental check, 2) developmental check, and 3) end of developmental check to otolith edge. These areas are referred to as 'regions' for the purpose of this study (Figure 3). All linear measurements on otolith samples were recorded and input to a database. All samples were analyzed twice with a lapse of three weeks between analyses to avoid reader bias as the same reader conducted both analyses.

Identification and enumeration of spring Chinook salmon from screw trap samples

Prepared otolith samples were visually examined for incremental patterns and checks associated with the natal portion of the otolith using a transmitted light microscope interfaced with a video camera and a computer equipped with image analysis software. For purposes of this investigation, the natal portion of the otolith included the area of the otolith prior to and including the developmental check region (DC) since increment deposition in this portion of the otolith occur during intragravel development. The developmental check region is the area of the otolith located between the hatch and emergence checks (width). This area denotes the developmental life stage of the fish and the associated incubational thermal regimes that are site specific.

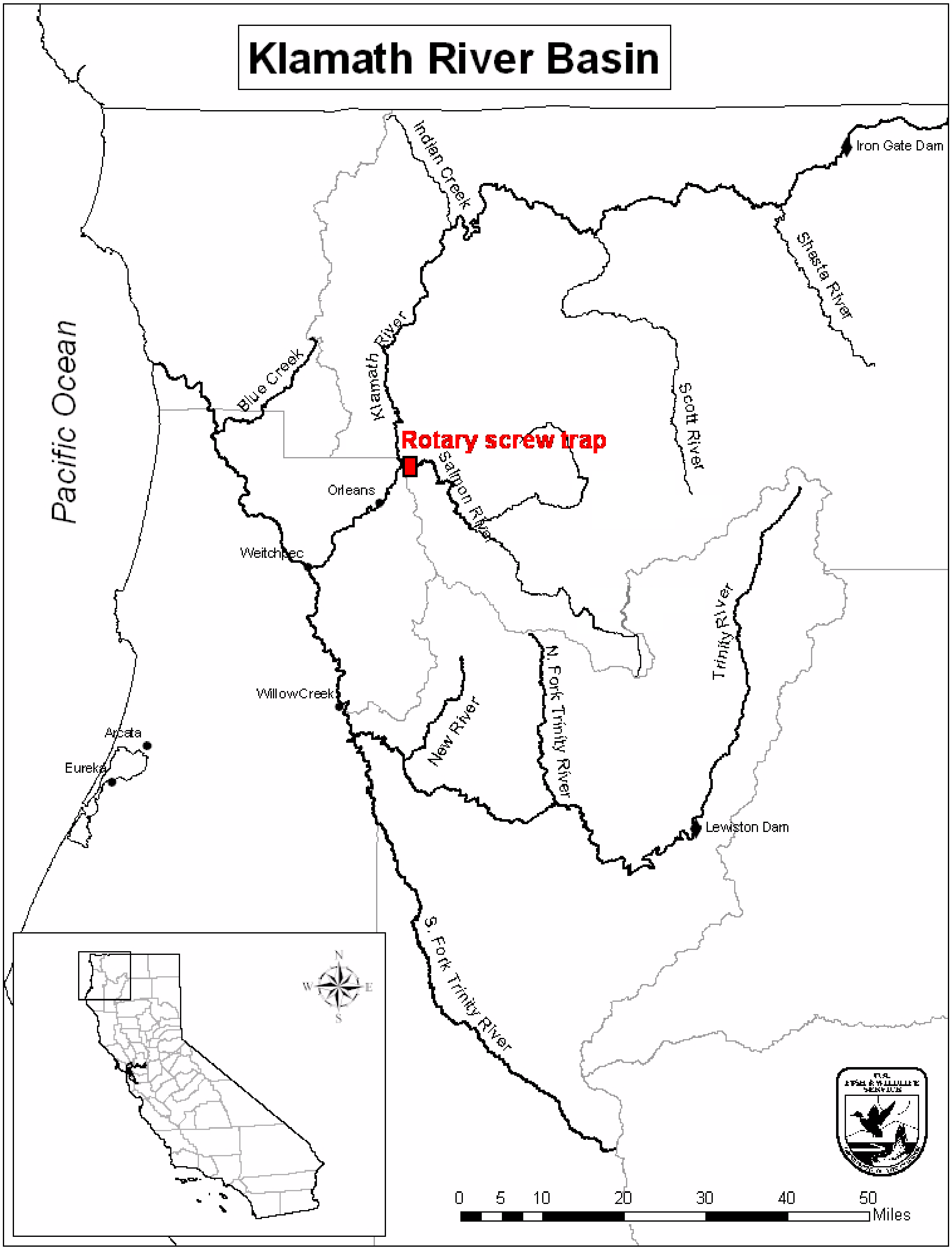

Figure 1. Map of Salmon River rotary screw trap site located in northwestern California.

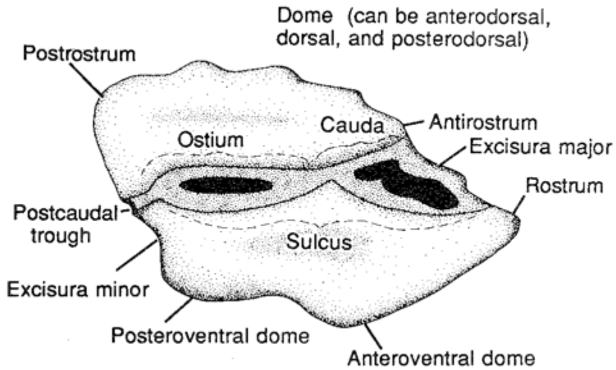

Figure 2. Diagram of a sagittal otolith from a generalized teleost fish (from Cailliet *et al*. 1986).

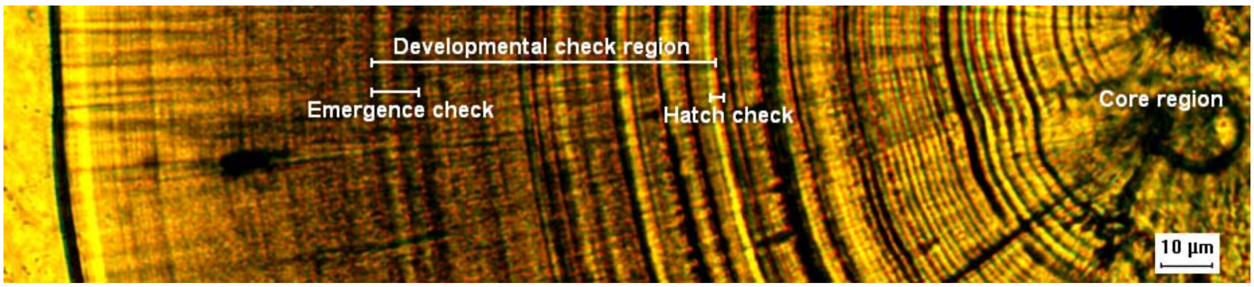

Figure 3. Developmental check sequence of an otolith extracted from a juvenile Chinook salmon originating in the Salmon River sub-basin, CA in 2004.

During visual examination of the collected Salmon River screw trap samples, individual otolith samples were grouped by similarities in appearance. Descriptions of the microstructural patterns for each group of otolith samples were then recorded and compared to a previous documented description of the developmental check region of juvenile Salmon River spring Chinook salmon (Sartori 2005).

Upon completion of the visual analysis, linear measurements of the developmental check regions of all viable Salmon River screw trap otolith samples were taken and recorded to a database. A database query was then performed on linear distances of the developmental check regions of the screw trap otolith samples (distance from otolith core and the width of the developmental check region) to identify the samples that had similar developmental check measurements by using the range of the developmental check measurements found in the otolith samples previously identified as Salmon River spring Chinook salmon (Sartori 2005). Results of this comparative database query was documented, recorded and compared to the results of the visual examination of the screw trap samples.

All samples were visually analyzed twice with a lapse of three weeks between analyses to avoid reader bias as the same reader conducted both visual examinations.

Identification of hatch and emergence checkmarks

Hatch checkmarks of salmonids usually appear in the form of a very dark band or structural discontinuity from previous increments. An emergence checkmark occurs prior to a transitional area from broad or indistinct increments of the post-hatch alevin to the well-defined daily incremental banding of emergent fry (Volk *et al*. 1995).

Prepared otolith samples were visually examined using a transmitted light microscope interfaced with a video camera and a computer equipped image analysis system to determine the appearance of the hatch and emergence checkmarks that occur in the natal portion of the otolith. During visual examination of all viable otolith samples collected at the Salmon River trap site, the hatch check was identified as a distinct dark band followed by a distinct light band that was located beyond the core region of the otolith samples, but preceded an area of broad or indistinct increments that is representative of otolith increments found on post-hatch alevin (Volk *et al*. 1995). Consequently, the emergence check was identified as a series of three dark bands separated by two lighter bands that represented a transitional area from the broad or indistinct increments of the post-hatch alevin to the well defined daily incremental banding of emergent fry. Figure 3 shows the identified hatch and emergence checks located on all Salmon River trap otolith samples.

On conclusion of the visual examination, linear measurements were taken from a consistently prominent nucleus located in the core region of all usable otolith samples outward to the visually identified hatch and emergence checkmarks along a specific radial angle. All measurements were recorded and input to a database.

Freshwater residency and growth rates

To estimate freshwater residency and associated growth rates, it was necessary to first establish a relationship between the fish fork length and the otolith radius. Once the relationship was established, otolith increments were manually marked from the end of the core region of the otolith to the edge of the otolith using a transmitted light microscope interfaced with a video camera and a computer equipped with image analysis software. Measurements included distances between ends of core region to hatch check, hatch check to emergence check, emergence check to edge of otolith, and between individual otolith increments.

Assuming one otolith increment represents one day and counting the number of increments in the freshwater portion of the otolith, it is possible to estimate the number of days an individual fish had resided in the Salmon River prior to collection at the trap site. By estimating the fork length of individual fish samples when they emerged using the model generated by regressing fish length to otolith length, and subtracting this estimate from the measured fork length at time of collection, it is possible to estimate the amount individual fish grew in length while rearing in the Salmon River before being collected at the trap site. By dividing the estimated amount of growth by the number of days residing in the Salmon River yields a growth rate (mm/day) for individual fish.

Data analysis

To establish the relationship between fish length and otolith radius, simple linear regression was applied to regress fish fork lengths (mm) against corresponding otolith radii (µm). Assuming that otolith increment deposition is daily, the fish fork length:otolith radius model generated from the linear regression, and linear measurements of specific otolith characteristics such as hatch check, emergence check, incremental widths, etc.; it is possible to obtain an estimation of size and growth rates of individual fish for specific life history events such as hatch and emergence, specific daily age, or habitat transitions.

By counting the increments from the emergence check outward to the edge of the otolith and assuming that increments are deposited daily, an estimate of daily age and freshwater residency of the collected juvenile Chinook salmon samples is accomplished if the fish was collected in freshwater. Furthermore, by inputting the linear distance of the emergence check from the otolith core to the fish length:otolith length model to obtain an estimate of fish length at emergence; the resulting fish length estimate is subtracted from the fish length at collection to estimate amount of growth from emergence to time of collection. To estimate daily growth rates per fish, the estimated amount of growth post-emergence to the edge of the otolith (time of collection) is divided by the number of increments encompassed in this area which yields a growth rate (mm/day) for freshwater residency as the fish used in this study were collected as juvenile migrants in freshwater.

To test for difference in linear distance of the developmental check region in terms of distance from otolith core and width on all grouped screw trap otolith samples (grouped by microstructural pattern), an independent *t*-test (Murphy and Willis 1996) was conducted using the following equation:

$$t = (\bar{y}_1 - \bar{y}_2)\sqrt{\frac{n_1 n_2}{n_1 + n_2}} \Big/ \sqrt{\frac{(n_1 - 1)s_1{}^2 + (n_2 - 1)s_2{}^2}{n_1 + n_2 - 2}}$$

where t = statistical difference between two sample means, $\bar{y}$ = sample means, s^2 = sample variances, and n = sample sizes. This test was also applied between any group of screw trap otolith samples that displayed similar developmental check distances and widths to a previous collection of otolith samples collected from known spring Chinook salmon spawning grounds of the Salmon River (Sartori 2005).

To determine if there was a significant change in growth rates during residency in the freshwater rearing habitat of the Salmon River for individual fish collected in the screw trap, a paired t-test was performed on specific growth rates of otolith incremental regions of individual fish (Murphy and Willis 1996) as using the equation:

$$t = \frac{\bar{d} - \mu_d}{s_d / \sqrt{n}}$$

where t = statistical difference between two samples of paired data (growth rates), $\bar{d}$ = the point estimate of the mean difference, μ_d is the hypothesized mean difference of 0, s_d = standard deviation, and n = sample size.

Results

Identification and enumeration of spring Chinook salmon from screw trap samples

Of the total 66 juvenile Chinook salmon live-box mortalities salvaged from the Salmon River rotary screw trap site between the years of 2003 to 2005, 58 otolith samples were viable for this investigation (Table 1). Eight otolith samples were not used due to one or more of the following circumstances: unacceptable radial angle, abnormal crystalline formation of otolith, uneven microstructural growth patterns along radial angle, loss of part or whole otolith, or poor sample preparation.

Visual examination of the 58 otolith samples collected from the screw trap resulted in identification of two distinct developmental check patterns. Qualitative corroboration of the visible separation of two distinct developmental check patterns of the trap samples was accomplished by overlaying a sub-sample (n = 15 for each developmental check pattern) of one developmental check pattern over the other developmental check pattern using an image analysis system. The overlay of one developmental check pattern over the other developmental check pattern resulted in a visible difference in the distance from the otolith core and in width.

By using the overlay method and a sub-sample of a previously identified Salmon River spring Chinook salmon developmental check pattern (Sartori 2005), one screw trap developmental check pattern resulted as having the same developmental check pattern as the Salmon River spring Chinook salmon one. The number of screw trap samples exhibiting the Salmon River spring Chinook salmon developmental check pattern was a total of 18 otolith samples. To determine if the screw trap otolith samples were significantly different from each other and from the previously identified Salmon River spring Chinook salmon otolith samples, independent sample *t*-tests and 'analysis of variance' tests (ANOVA's) were conducted on linear measurements of all usable otolith samples.

Table 1. Number of otoliths collected from juvenile Chinook salmon sampled from a rotary screw trap located 1.5 rkm upriver from the confluence of the Salmon River and the Klamath River, Ca.

Sample Year	No. of Otoliths Collected	No. of Otoliths Usable	Range of Dates
2003	10	8	8/29/2003
2004	32	27	06/07/2004-09/15/2004
2005	27	23	09/27/2005-10/03/2005

The linear measurement comparison of the developmental check region of the 18 otolith samples that exhibited the Salmon River spring Chinook salmon developmental check pattern resulted in no significant difference in distance from the otolith core region and in the width of the developmental check region between the screw trap otolith samples independent of year (ANOVA, $F_{2, 15} = 0.08$, $p = 0.92$; and $F_{2, 15} = 0.78$, $p = 0.47$ respectively). Annual mean linear otolith region distances and widths of developmental check regions representing the screw trap samples that were visibly similar to the Salmon River spring Chinook salmon developmental check regions are listed in Table 2.

When comparing the mean developmental check region linear measurements of the trap samples (n = 18) that were visibly similar to a previously identified Salmon River spring Chinook salmon otolith developmental check pattern (n = 91) using an independent sample *t*-test, there was no significant difference in linear distance from the core region or in the developmental check regional width ($t_{107} = 0.39$, $p = 0.35$; and $t_{107} = 0.58$, $p = 0.29$, respectively). Table 3 summarizes mean linear distances from core region and widths of the developmental check regions found in the otolith samples collected from the Salmon River trap site and from known spring Chinook salmon spawning grounds.

The remaining otolith samples (n = 40) collected for this study shared a specific developmental check pattern that was visibly dissimilar to the developmental check region of the spring Chinook salmon otolith samples. Although the hatch and emergence checks were similar in appearance to the identified spring Chinook salmon otolith samples, the linear distance of the developmental check region from the core region and the developmental check width appeared different (Figure 4). Comparison of the two different developmental check regions represented in the trap otolith samples resulted in a significant difference in the linear distance from the core region and in width ($t_{56} = -7.42$, $p < 0.00$; and $t_{56} = 32.95$, $p < 0.00$, respectively). Table 4 summarizes mean linear developmental check distances from otolith core and the developmental check widths of the two representative Salmon River trap otolith developmental check patterns.

Table 2. Summary of mean linear distances of the developmental check region (DC) from the otolith core (C) and the DC width on all otolith samples collected from the Salmon River rotary screw trap that displayed the Salmon River spring Chinook salmon (SRSP) developmental check pattern.

Year	Otolith Region	Mean (μm)	SE (μm)	n
2003	C to DC	60.77	2.73	3
	DC	87.73	0.63	
2004	C to DC	59.65	1.49	10
	DC	88.54	0.34	
2005	C to DC	59.50	2.11	5
	DC	88.65	0.48	

Table 3. Summary of mean linear distances of the developmental check region (DC) from the otolith core (C) and the DC width of otolith samples collected from the Salmon River screw trap that displayed the same developmental check pattern as otolith samples collected from known Salmon River spring Chinook salmon spawning grounds.

Site	Otolith region	Mean (µm)	SD (µm)	n
Spawning grounds	C to DC	60.15	3.27	91
	DC	88.63	1.37	
Rotary screw trap	C to DC	59.80	4.46	18
	DC	88.43	1.07	

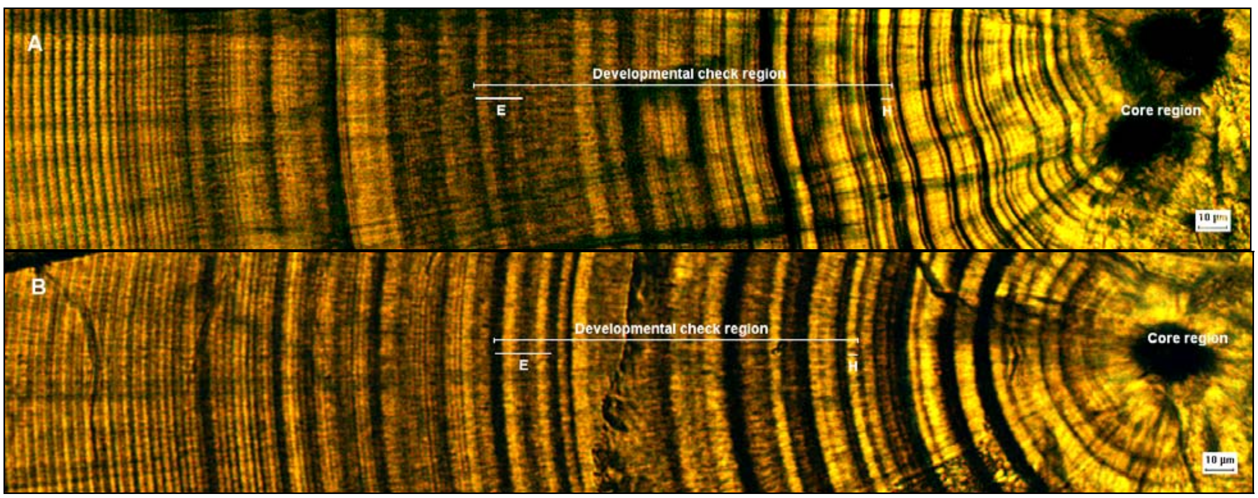

Figure 4. Representative developmental check regions of otoliths from juvenile Chinook salmon salvaged from the Salmon River rotary screw trap in 2004. (A) Shows the developmental check region displayed by Salmon River spring Chinook salmon and (B) shows the developmental check region of an unspecified Salmon River Chinook salmon stock.

Although the developmental check region on 40 of the otolith study samples collected at the Salmon River trap site was significantly different from that of the other 18 otolith samples which displayed a similar developmental check region to that of a previously identified spring Chinook salmon developmental check (Sartori 2005), there was no significant difference among the 40 samples in linear distance from the otolith core or in width between sample years (ANOVA, $F_{2, 37} = 0.21$, p = 0.81; and $F_{2, 37} = 0.13$, p = 0.88, respectively). Annual mean linear otolith regions distances and width of the screw trap samples that were not identified as having the developmental check pattern of the previously identified Salmon River spring Chinook salmon are listed in Table 5 as 'SR-A'; whereas the Salmon River spring Chinook salmon otolith samples are listed as 'SRSP'.

Table 4. Mean linear distances of the developmental check region (DC) from the otolith core (C) and the DC width on identified juvenile spring Chinook salmon otolith samples (SRSP) and unspecified juvenile Chinook salmon otolith samples (SR-A) collected from the Salmon River rotary screw trap. Otolith samples represent collection years 2003-2005.

Site	Otolith pattern	Otolith region	Mean (µm)	SD (µm)	n
Salmon River screw trap	SRSP	C to DC	59.80	4.46	18
		DC	88.44	1.07	
	SR-A	C to DC	75.67	8.54	40
		DC	65.76	2.82	

Table 5. Mean linear distances of the developmental check region (DC) from the otolith core (C) and the DC width on all unspecified Salmon River juvenile Chinook salmon otolith samples.

Year	Otolith Region	Mean (µm)	SE (µm)	n
2003	C to DC	76.47	3.90	5
	DC	65.23	1.29	
2004	C to DC	74.63	2.11	17
	DC	65.95	0.70	
2005	C to DC	76.43	2.05	18
	DC	65.73	0.68	

Since there are no documented baseline Salmon River juvenile Chinook salmon otolith samples that display the same developmental check pattern as the 40 screw trap samples, the specific origin of these samples remain unknown.

Freshwater residency and growth rates

Fish fork length was correlated with corresponding otolith radii (Figure 5, $r = 0.88$, $n = 58$) and was used in conjunction with the assumption that otolith increment deposition was daily to estimate freshwater residency and associated growth rates. Overall mean freshwater residency was estimated to be 136 days $\pm$ 31 days with an overall mean growth rate of 0.23mm/day $\pm$ 0.09 mm/day.

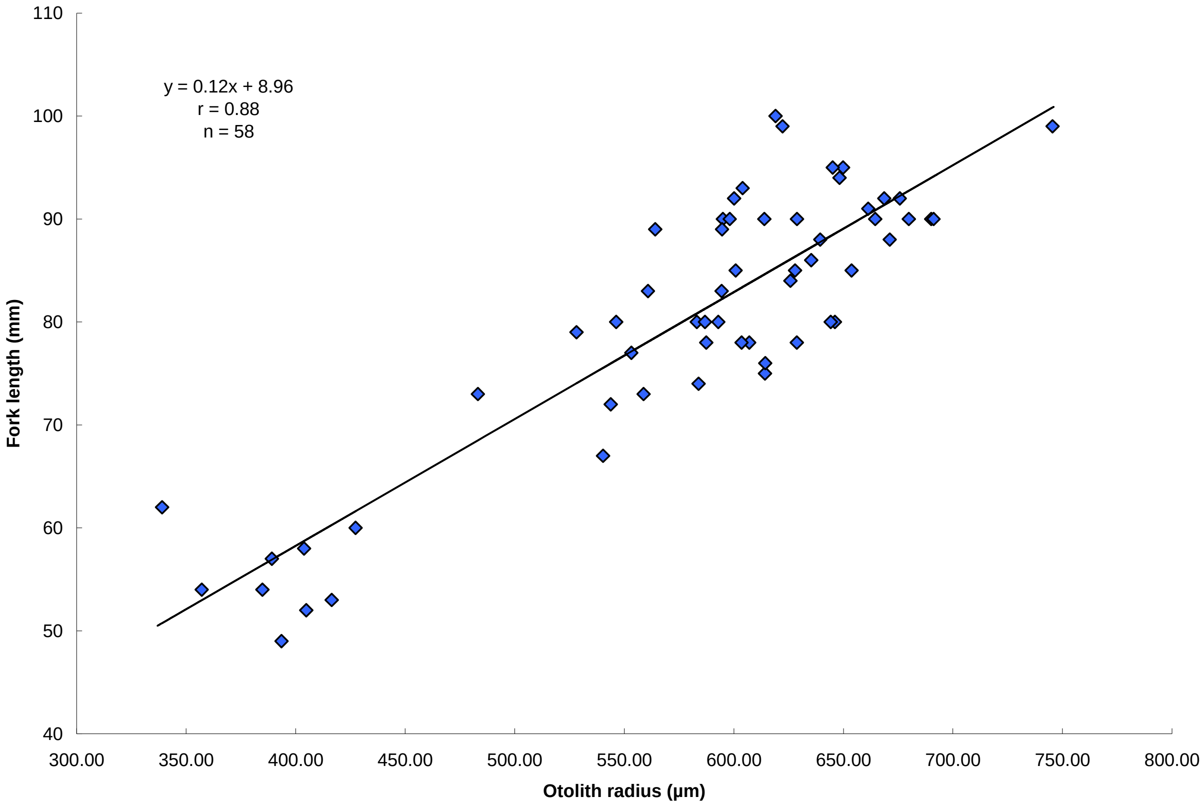

Figure 5. Relationship between fish fork length (mm) and otolith radius (µm) of juvenile Chinook salmon collected from the Salmon River rotary screw trap site between the years 2003-2005.

Incremental widths normally associated with freshwater generally average < 3 µm in width (Neilson *et al*. 1985, Beamer *et al*. 2000) for juvenile Chinook salmon. However, during visual analyses of the otolith samples used in this study, there was an observed increase in incremental width (Figure 6) on 57 of the 58 otolith samples which indicated a change in the freshwater growth rate. Linear measurements of these areas of observed increased incremental widths supported the visual observations. The mean incremental widths changed from a typical (< 3 µm) freshwater mean incremental width of 2.48 µm ± 0.16 µm to an atypical (> 3 µm) freshwater mean incremental width of 3.38µm ± 0.18 µm per individual fish. The associated growth rate for this group of increased incremental widths was 0.39 mm/day ± 0.02 mm and the residency period represented by the increased incremental widths was approximately 25 days. The mean overall fork length of fish at the beginning of the increased incremental width otolith area was approximately 58 mm ± 8 mm and was approximately 68 mm ± 10 mm at the end of the increased incremental width otolith area. The mean growth rate for this area of increased incremental width was approximately 0.39 mm/day ± 0.02 mm which was dissimilar to the mean growth rate of approximately 0.22 mm/day ± 0.09 mm for the other post-emergent otolith increments.

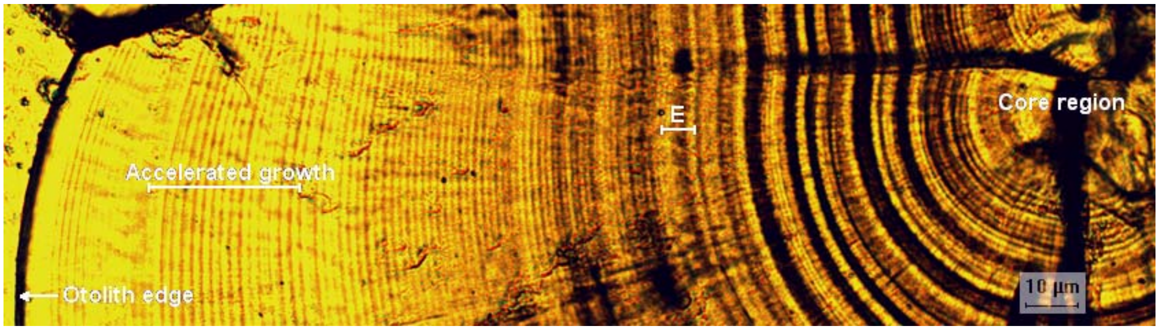

Figure 6. Representative otolith sample collected from the Salmon River rotary screw trap displaying an area of increased incremental widths located beyond the emergence check (E) and prior to the edge of the otolith (i.e. time of collection).

Results of a paired *t*-test indicated that there was a significant difference between the typical freshwater incremental widths and the atypical freshwater incremental widths ($t_{56} = 13.44$, n = 57, p<0.00).

Only otolith samples with more than 10 consecutive sequential increments that displayed atypical freshwater incremental widths were used to determine the amount of change in width and ultimately the amount of change in growth rates per individual fish. Assuming that incremental deposition is daily, incremental counts > 10 indicated that migrating juvenile Chinook salmon had settled in a particular area of the river longer than a week before resuming migration to the estuary and/or ocean. Table 6 summarizes the overall mean residency times and associated growth rates for the different types of freshwater growth increments (typical and atypical).

Identification of hatch and emergence checkmarks

Although similar hatch and emergence checkmarks were identified on all trap samples, the location of the hatch check was found to be pattern-selective. Mean linear distance between the hatch check and the end of the core region for otolith samples exhibiting the same developmental check pattern as the Salmon River spring Chinook salmon developmental check pattern was 60.15 µm $\pm$ 3.27 µm; whereas the mean linear distance between the hatch check and the end of the core region for the other identified developmental check pattern of the screw trap samples was 75.67 µm $\pm$ 8.54 µm. Results of a two sample *t*-test indicated there was a significant difference between the two developmental check patterns identified in the screw trap samples in terms of the overall mean linear hatch check distance from the core region ($t_{56} = -7.42$, p < 0.00) and the overall mean linear distance of the emergence check from the core region ($t_{56} = 3.07$, p < 0.00).

Table 6. Overall mean freshwater residency and associated growth rates categorized by type of freshwater otolith increment for all juvenile Chinook salmon otolith samples collected during the secondary migration peak of the Salmon River, CA between the years 2003-2005.

Site	n	Freshwater increment category	Mean increment width (µm) ± SD	Mean increment count ± SD	Mean growth rate/day (mm) ± SD
Salmon River trap site	57	Typical	2.49 ± 0.16	112 ± 28	0.23 ± 0.09
		Atypical	3.38 ± 0.19	25 ± 10	0.39 ± 0.02

Discussion

Variation in temperature and growth can produce otolith increment patterns that are stock specific, provided the stock incubated under a distinctive thermal regime (Zhang *et al*. 1995, Volk *et al*. 1996, Quinn *et al*. 1999). The resulting increment pattern is specific to the thermal regime under which embryonic and alevin development occurred (Quinn *et al*. 1999). In this study, the developmental check region encompassed the area between the hatch check and the emergence check which were included as part of the check region. Visual examinations of the prepared Chinook salmon otolith samples salvaged from the Salmon River rotary screw trap indicated two distinct developmental check patterns. One particular developmental check pattern was more prevalent than the other during the visual examinations and was not similar in distance from core region and width in comparison to the known Salmon River spring Chinook salmon developmental check pattern when compared using an independent sample *t*-test.

The predominant developmental check pattern (69% of total sample size) had no previous juvenile spawning-ground baseline data and so was arbitrarily given a misnomer of 'SR-A' to indicate an unidentified Chinook salmon stock, whereas the remaining 31% otolith samples were identified as having a Salmon River spring Chinook salmon developmental check microstructural pattern ('SRSP'). As the Salmon River supports both fall- and spring-run Chinook salmon, the 'SR-A' otolith samples may possibly be representative of Salmon River fall Chinook salmon; although this is a best-guess scenario since there is no juvenile baseline data to support this theory. Both Salmon River developmental check patterns were visually different from other collected Klamath River basin juvenile Chinook salmon otolith samples. The other Klamath River basin sites included Iron Gate hatchery, Trinity River hatchery, and the upper Trinity River mainstem near the Trinity River hatchery (Figures 7-9). The visual differences among the otolith collections suggest that the developmental thermal regimes varied between collection sites.

The Salmon River spring Chinook salmon are known to spawn in the North- and South-Forks of the river, but not in the mainstem portion of the river, whereas the fall-run

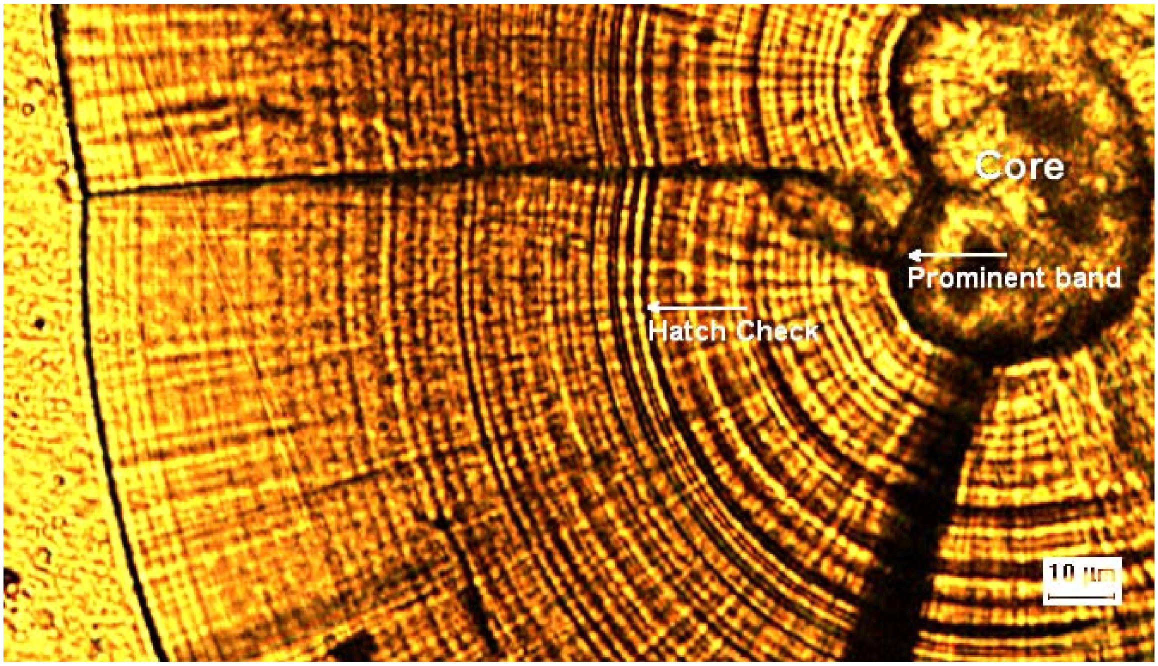

Figure 7. Image of otolith microstructural pattern representative of fall Chinook salmon from Iron Gate Hatchery located in Siskiyou County, CA. Note the prominent band surrounding the core region which differentiates this particular pattern from other Klamath Basin patterns sampled thus far.

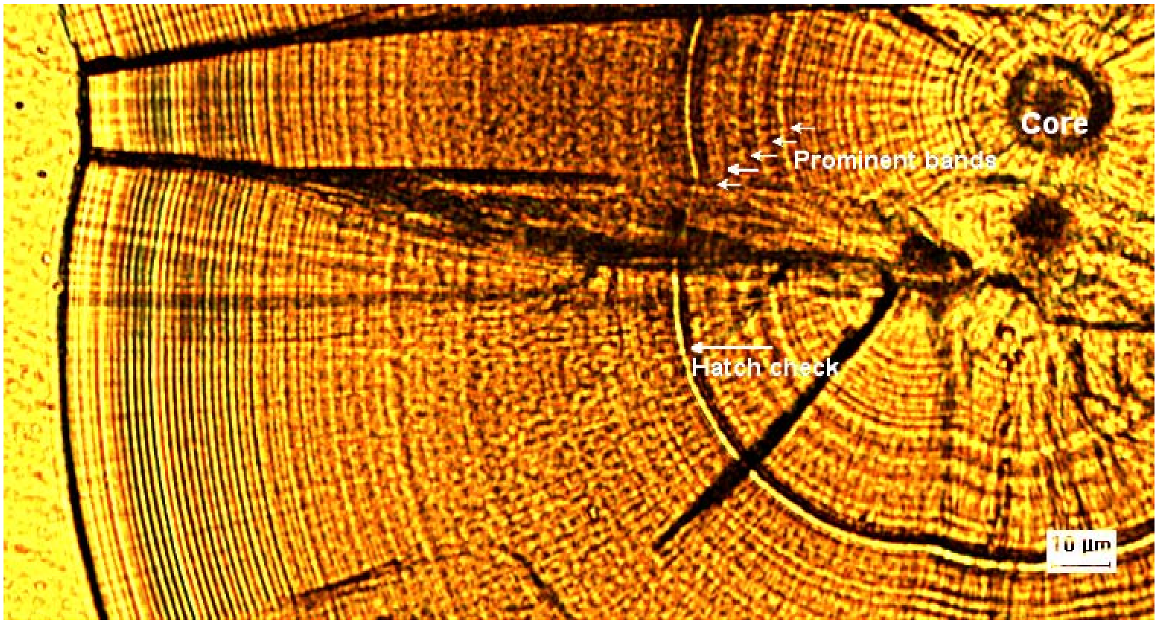

Figure 8. Image of otolith microstructural pattern representative of fall Chinook salmon from the Trinity River Hatchery located in Trinity County, CA. Note the five prominent bands occurring prior to the hatch check.

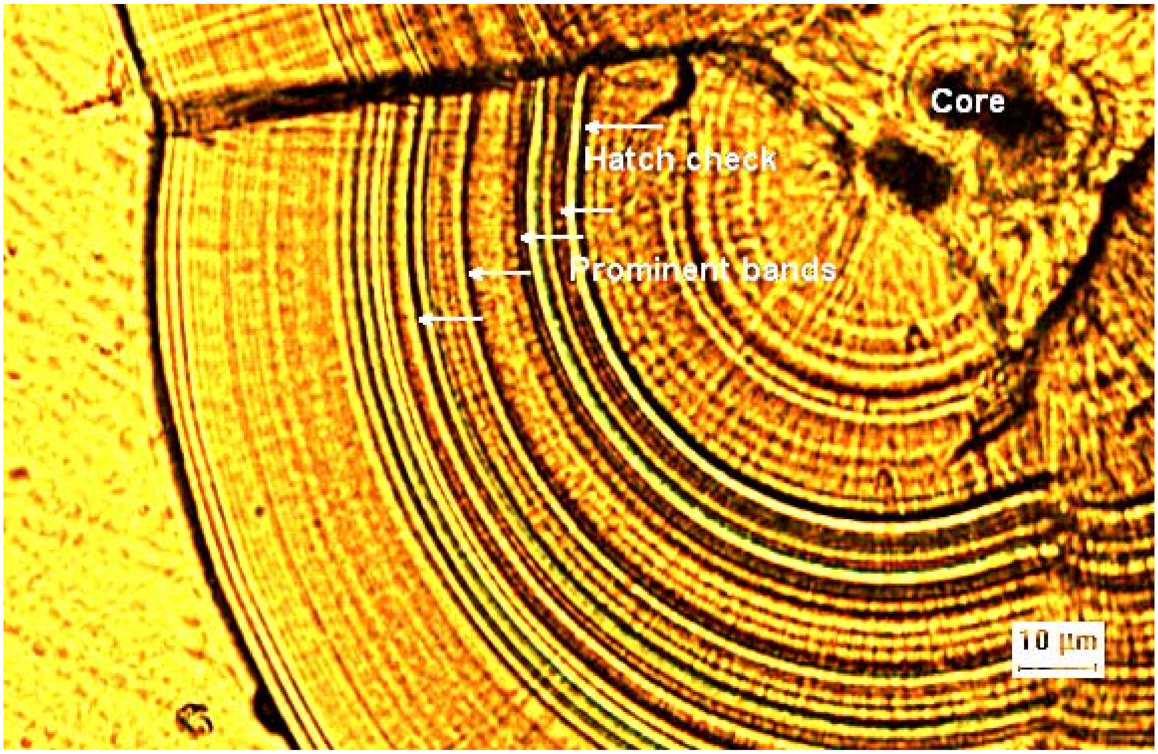

Figure 9. Image of an otolith microstructural pattern of a Chinook salmon sampled from upper Trinity River mainstem located in Trinity County, CA. Note the four prominent bands post hatch check.

Chinook salmon is known to only spawn in the river's mainstem and lower tributaries (P. Brucker and N. Pennington, Salmon River Restoration Council, personal communication). Once emergence occurs, rearing and emigration of both fall-and spring-run Chinook salmon occur during the same time periods (Table 7) which makes it possible to have both runs migrating through the trap site in the same time frame. Without recorded intra-gravel thermal regimes of known fall- and spring-run Chinook salmon incubational sites, any identification of fall- and spring-run Chinook salmon originating in the Salmon River sub-basin is preliminary until such data is available to correlate otolith natal microstructure to site specific thermal regimes.

Comparative results between the developmental check patterns of previously identified spring Chinook salmon otolith samples and developmental check patterns of otolith samples salvaged from the trap site exhibiting similar developmental check patterns of the spring Chinook salmon were not significantly different in either distance from the otolith core region or in width. This would suggest that all the screw trap otolith samples that displayed the similar developmental check region as the otolith samples collected from known Salmon River spring Chinook salmon spawning grounds were affected by similar incubational thermal regimes.

Table 7. Salmon River, CA life stage periodicity table for Chinook salmon. Table is courtesy of the Natural Resources Department of the Karuk Tribe.

Species/Life Stage	Run	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Redd construction	Spring									X	X		
	Fall										X	X	
Egg incubation/fry emergence	Spring	X	X	X	X	X				X	X	X	X
	Fall	X	X	X	X	X					X	X	X
Fry rearing (up to 50 mm)	Spring				X	X	X	X					
	Fall				X	X	X	X					
Juvenile YOY rearing (>50 mm)	Spring				X	X	X	X	X	X	X	X	X
	Fall				X	X	X	X	X	X	X	X	X
Juvenile yearling rearing (>50 mm)	Spring	X	X	X									
	Fall	X	X	X									
Juvenile emigration (>50 mm)	Spring	X	X	X	X	X	X	X	X	X	X	X	X
	Fall	X	X	X	X	X	X	X	X	X	X	X	X

One consistent similarity for all otolith samples salvaged from the trap site during the secondary migration peak, regardless of possible run-type, was an area of sequential post-emergent increments that had dramatically increased in width from other post-emergent increments prior to otolith collection. One otolith sample was not used in this portion of the analysis due to the small number of increments in this particular area of the otolith (n <10). This area of increased incremental width suggests an increase in fish growth since it is generally accepted that otolith increment width is an indicator of fish growth if fish length is correlated to otolith diameter (Volk *et al*. 1984, Thorrold and Williams 1989). For this investigation, there was a positive correlation between fish fork length to otolith radius (r = 0.88).

The increase of freshwater otolith incremental widths from a mean of 2.49 µm to a mean of 3.38 µm is typically seen in habitat areas just prior to an estuarine habitat (Beamer *et al*. 2000) which is different from the location of the Salmon River trap site from which the otolith samples were obtained. In the study conducted by Beamer *et al*., the habitat just prior to the Skagit River estuary exhibited mean incremental widths of 3.68 µm $\pm$ 0.49 µm which was dissimilar to the mean freshwater increments found on the same Skagit River otoliths (2.31 µm $\pm$ 0.10 µm). One possible explanation for this increased freshwater incremental width anomaly is a transition from an unfavorable freshwater habitat to a habitat which encompassed environmental variables more favorable to fish growth. Habitat variables such as optimum water temperatures, low population densities, and an abundance of prey would facilitate increased fish growth that would be represented by increased otolith incremental widths (Neilson *et al*. 1985).

Otolith microstructure of collected emigrating Salmon River juvenile Chinook salmon indicated an overall mean residency of approximately 25 days in the proposed “optimal freshwater habitat” with a calculated mean increase in fish fork length of 10mm. This increase in growth during the residency period in the proposed freshwater habitat suggests that environmental conditions were conducive to fish growth as indicated by the change in otolith incremental widths. To understand why fish reside in the proposed habitat instead of continuing migration to the estuary and/or ocean, an examination of riverine conditions should be examined.

Salmon River juvenile Chinook salmon migrating to the estuary and/or ocean must first transition from the Salmon River into the Klamath River during the months from April to October. As the otolith samples collected for this study only reflect the latter months of the migration season (approximately August through October), only the riverine conditions during those months will be discussed. Personal communication with T. Soto, Department of Natural Resources of the Karuk Tribe, and N. Pennington, Salmon River Restoration Council; indicated that poor water quality conditions existed in the Klamath River prior to the secondary migration peak between the years 2003-2005 such as increased water temperatures and an increase in algal concentrations. If the water quality conditions were an impediment to juvenile Salmon River Chinook salmon transitioning to the Klamath River, a possibility of the fish remaining in the Salmon River until water quality conditions improved may have existed. Accordingly, there was no visible checkmark that may have associated a transition from the Salmon River to the Klamath River found on any of the otolith samples used in this study. Without a visible checkmark on the otoliths denoting a transition from the Salmon River to the Klamath River, any increase in incremental widths would be assumed to have occurred in the Salmon River.

This report identified the number of juvenile spring Chinook salmon of the total sample group collected from the live-box of the Salmon River rotary screw trap during the secondary migration peak between the years 2003-2005 based on otolith microstructure. Other otolith characteristics identified were freshwater residency rates, growth rates, and specific life-history microstructural checks. However, results of this study were limited due to annual and overall small sample sizes, absence of otolith samples representing the primary peak of emigrating juvenile Chinook salmon, and absence of baseline fall Chinook salmon natal spawning ground data. Additional studies are needed to confirm specific natal microstructural signatures of spring and fall Chinook salmon stocks of the Salmon River, including: 1) otolith studies on fall-run Chinook salmon fry otoliths collected from known spawning grounds in the Salmon River sub-basin, 2) otolith studies of spring and fall Chinook salmon adults from spawning grounds in the Salmon River sub-basin, 3) identification of the relationship between incubational thermal regimes of known spring and fall Chinook salmon natal grounds and associated otolith microstructural pattern, 4) genetic analyses of identified spring and fall Chinook salmon derived from otolith microstructure, and 5) a comparative study of spring Chinook salmon fry otolith microstructure from the Salmon River to microstructure of other river systems outside the Klamath Basin.

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Pennington, N. Salmon River Restoration Council, Sawyers Bar, CA.

Pinnix, W. U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata, CA.

Soto, T. Karuk Tribe, Department of Natural Resources, Orleans, CA.

Date	Reach	Redd #	Redds Observed	# of fish on redd	% Canopy Over Redd	Instream Cover (none, wood, boulder, white water, undercut ledge, pool)	Proximity to instream cover in ft.
9/21/2006	Petersburg- East Fork	1	1	0	50	None	2
9/21/2006	Blindhorse - Petersburg	1		1	75	None	-
9/21/2006	Blindhorse - Petersburg	2		4	0	pool/pool	25
9/21/2006	Blindhorse - Petersburg	3		3	5	pool/ white water	20/25
9/21/2006	Blindhorse - Petersburg	4	4	0	5	pool	30
9/21/2006	Cecil - Limestone	1	1	0	0	none	n/a
9/21/2006	Georges - Confluence	0	0	0	n/a	n/a	n/a
9/21/2006	Little South Fork - Grizzly	1		0	0	white water	10
9/21/2006	Little South Fork - Grizzly	2		0	0	pool/ ledge	40
9/21/2006	Little South Fork - Grizzly	3		0	60	pool/ ledge	50
9/21/2006	Little South Fork - Grizzly	4		0	30	pool/ ledge	55
9/21/2006	Little South Fork - Grizzly	5		0	75	pool/ white water	75
9/21/2006	Little South Fork - Grizzly	6		1	0	pool	30
9/21/2006	Little South Fork - Grizzly	7		1	0	boulder/ white water	25
9/21/2006	Little South Fork - Grizzly	8		1	0	pool/ledge	25
9/21/2006	Little South Fork - Grizzly	9		1	0	pool/ledge	35
9/21/2006	Little South Fork - Grizzly	10	10	0	10	boulder/ white water	30
9/21/2006	East fork - Cecil Creek	1		1	35	undercut ledge	1 / zero
9/21/2006	East fork - Cecil Creek	2		1	15	none	0
9/21/2006	East fork - Cecil Creek	3	3	0	30	white water/ pool	15/35
9/27/2006	Cecilville - French	1		1	10	pool	40
9/27/2006	Cecilville - French	2		1	10	pool	30
9/27/2006	Cecilville - French	3	3	0	5	wood	10
9/28/2006	E. Fork - Cecil Creek	1		0	50	wood, ledge	5
9/28/2006	E. Fork - Cecil Creek	2		0	5	none	N/A
9/28/2006	E. Fork - Cecil Creek	3	3	0	30	none	N/A
9/28/2006	Limestone - Smith Creek	1		0	5	rock/ log/ bubbles	40
9/28/2006	Limestone - Smith Creek	2		0	5	rock/ log/ bubbles	40
9/28/2006	Limestone - Smith Creek	3		0	5	rock/ log/ bubbles	40
9/28/2006	Limestone - Smith Creek	4		0	5	rock/ log/ bubbles	40
9/28/2006	Limestone - Smith Creek	5		0	20	none	n/a
9/28/2006	Limestone - Smith Creek	6		1	35	rock	10
9/28/2006	Limestone - Smith Creek	7		0	35	rock	5
9/28/2006	Limestone - Smith Creek	8		0	3	white water	10
9/28/2006	Limestone - Smith Creek	9		1	45	pool	30
9/28/2006	Limestone - Smith Creek	10		1	45	pool	20
9/28/2006	Limestone - Smith Creek	11		0	35	white water/pool	15-20
9/28/2006	Limestone - Smith Creek	12		1	30	pool	30+
9/28/2006	Limestone - Smith Creek	13		1	20	pool	30+

9/28/2006	Limestone - Smith Creek	14		0	50	pool		40
9/28/2006	Limestone - Smith Creek	15	15	0	5	pool		50
9/28/2006	Little Grizzly - Blindhorse	1		0	5	undercut ledge		20
9/28/2006	Little Grizzly - Blindhorse	2		0	10	none	--	
9/28/2006	Little Grizzly - Blindhorse	3		0	20	whitewater		12
9/28/2006	Little Grizzly - Blindhorse	4		3	40	pool		24
9/28/2006	Little Grizzly - Blindhorse	5		1	15	undercut ledge		30
9/28/2006	Little Grizzly - Blindhorse	6		2	35	pool		18
9/28/2006	Little Grizzly - Blindhorse	7		0	65	none	--	
9/28/2006	Little Grizzly - Blindhorse	8		2	60	none	--	
9/28/2006	Little Grizzly - Blindhorse	9		1	50	none	--	
9/28/2006	Little Grizzly - Blindhorse	10		0	0	pool		20
9/28/2006	Little Grizzly - Blindhorse	11	11	0	10	whitewater		10
9/28/2006	Georges - East Fork	1	1	2	90	wood, undercut ledg		30
9/28/2006	Blindhorse - Petersburg	1		3	10	pool/ w. water		30
9/28/2006	Blindhorse - Petersburg	2		2	75	pool		30
9/28/2006	Blindhorse - Petersburg	3		5	0	pool		10
9/28/2006	Blindhorse - Petersburg	4		1	10	pool/ w. water		10
9/28/2006	Blindhorse - Petersburg	5		2	0	pool		30
9/28/2006	Blindhorse - Petersburg	6		1	0	pool		20
9/28/2006	Blindhorse - Petersburg	7		3	0	pool		35
9/28/2006	Blindhorse - Petersburg	8		1	5	pool		50
9/28/2006	Blindhorse - Petersburg	9	9	1	0	pool		30
9/28/2006	Petersburg - East Fork	1		2	10	none		15
9/28/2006	Petersburg - East Fork	2		1	10	none		3
9/28/2006	Petersburg - East Fork	3		0	60	disturbance wh. Wat		0.5
9/28/2006	Petersburg - East Fork	4		2	5	disturbance wh. Wat		0.5
9/28/2006	Petersburg - East Fork	5		1	25	disturbance wh. Wat		0.5
9/28/2006	Petersburg - East Fork	6	6	1	5	disturbance wh. Wat		3
10/3/2006	Little S. F. - blindhorse	1		0	0	pool		20
10/3/2006	Little S. F. - blindhorse	2	2	0	0	pool		40
10/4/2006	Idlewild - Whites gulch	1		1	40	pool		15
10/4/2006	Idlewild - Whites gulch	2		6	25	pool		15
10/4/2006	Idlewild - Whites gulch	3		0	25	pool		20
10/4/2006	Idlewild - Whites gulch	4		0	25	pool		25
10/4/2006	Idlewild - Whites gulch	5		1	30	pool		30
10/4/2006	Idlewild - Whites gulch	6		2	15	none	n/a	
10/4/2006	Idlewild - Whites gulch	7		1	40	none	n/a	
10/4/2006	Idlewild - Whites gulch	8		1	45	none	n/a	
10/4/2006	Idlewild - Whites gulch	9	9	2	20	pool		20
10/4/2006	Big Creek - Mule (I)	1		0	65	pool, terr. Veg		15
10/4/2006	Big Creek - Mule (I)	2	2	0	0	pool		15
10/4/2006	Mule Bridge - Idlewild	1		2	65	pool		30
10/4/2006	Mule Bridge - Idlewild	2		2	5	pool		40

10/4/2006	Mule Bridge - Idlewild	3	3	1	80	none	n/a	
10/5/2006	Petersburg - Eastfork	1		1	0	pool		5
10/5/2006	Petersburg - Eastfork	2		1	0	pool		15
10/5/2006	Petersburg - Eastfork	3		1	0	pool		15
10/5/2006	Petersburg - Eastfork	4	4	1	0	boulder/ wood		35
10/5/2006	East Fork	1		1	0	pool		20
10/5/2006	East Fork	2		6	0	pool		10
10/5/2006	East Fork	3		6	0	pool		10
10/5/2006	East Fork	4	4	1	60	pool		30
10/5/2006	Cecil - Limestone	1		0	90	none	n/a	
10/5/2006	Cecil - Limestone	2		1	90	wood		6
10/5/2006	Cecil - Limestone	3		4	10	boulder pool		3
10/5/2006	Cecil - Limestone	4		2	20	pool wood/ boulder		3
10/5/2006	Cecil - Limestone	5		0	75	undercut ledge		10
10/5/2006	Cecil - Limestone	6		1	90	undercut ledge		8
10/5/2006	Cecil - Limestone	7		0	0	boulder		10
10/5/2006	Cecil - Limestone	8		0	100	undercut ledge		8
10/5/2006	Cecil - Limestone	9		1	80	undercut ledge		4
10/5/2006	Cecil - Limestone	10		6	80	wood		1
10/5/2006	Cecil - Limestone	11		0	20	wood		2
10/5/2006	Cecil - Limestone	12		0	70	willow wood		0
10/5/2006	Cecil - Limestone	13		1	10	grass		4
10/5/2006	Cecil - Limestone	14		1	80	undercut ledge		3
10/5/2006	Cecil - Limestone	15		2	20	pool wood/ boulder		30
10/5/2006	Cecil - Limestone	16		6	100	undercut ledge		8
10/5/2006	Cecil - Limestone	17	17	2	90	grass		4
10/5/2006	East fork to Cecilville	1		0	0	None		0
10/5/2006	East fork to Cecilville	2		2	0	undercut ledge		5
10/5/2006	East fork to Cecilville	3	3	0	30	dead trees		20
10/5/2006	Blindhorse - Petersburg	1		0	0	pool		30
10/5/2006	Blindhorse - Petersburg	2		1	0	pool		30
10/5/2006	Blindhorse - Petersburg	3		0	40	pool		29
10/5/2006	Blindhorse - Petersburg	4		0	20	pool		49
10/5/2006	Blindhorse - Petersburg	5	5	0	0	pool		15
10/10/2006	Blindhorse - Petersburg	1		0	10	none	n/a	
10/10/2006	Blindhorse - Petersburg	2		0	0	pool		5
10/10/2006	Blindhorse - Petersburg	3	3	0	5	pool		25
10/12/2006	East Fork Salmon R.	0	0	0	n/a	n/a	n/a	
10/12/2006	East Fork - Cecil Creek	1		0	10	none	n/a	
10/12/2006	East Fork - Cecil Creek	2		3	40	white water and pool		10
10/12/2006	East Fork - Cecil Creek	3		0	0	pool		15
10/12/2006	East Fork - Cecil Creek	4		0	45	ledge/ boulder		15
10/12/2006	East Fork - Cecil Creek	5		0	55	ledge/ boulder		4
10/12/2006	East Fork - Cecil Creek	6		0	59	wood, willows		2

10/12/2006	East Fork - Cecil Creek	7	7	2	45	pool	15
10/12/2006	Petersburg -	1		2	20	Boulder	40
10/12/2006	Petersburg -	2		2	90	bank slightly underc	10
10/12/2006	Petersburg -	3		0	0	none	n/a
10/12/2006	Petersburg -	4		0	1	boulder, wood	6
10/12/2006	Petersburg -	5	5	2	20	ledge/ pool	50
10/12/2006	Smith - Matthews	1		0	0	0	N/A
10/12/2006	Smith - Matthews	2		0	0	0	N/A
10/12/2006	Smith - Matthews	3		0	0	0	N/A
10/12/2006	Smith - Matthews	4		0	0	0	N/A
10/12/2006	Smith - Matthews	5	5	0	40	0	N/A
10/12/2006	French - Smith	1		1	0	0	0
10/12/2006	French - Smith	2		0	20	0	20
10/12/2006	French - Smith	3		0	0	0	0
10/12/2006	French - Smith	4		0	0	0	0
10/12/2006	French - Smith	5		0	0	0	5
10/12/2006	French - Smith	6		0	0	0	0
10/12/2006	French - Smith	7		0	0	17	0
10/12/2006	French - Smith	8		1	0	0	1
10/12/2006	French - Smith	9		4	0	0	10
10/12/2006	French - Smith	10		0	0	0	10
10/12/2006	French - Smith	11	11	1	0	20	1
10/12/2006	Cecil - Limestone	1		3	70	pool	50
10/12/2006	Cecil - Limestone	2		0	5	w. water	15
10/12/2006	Cecil - Limestone	3		6	0	w. water	40
10/12/2006	Cecil - Limestone	4	4	1	75	w. water	8
10/12/2006	Little S. Fork - Blindhorse	0	0	0	N/A	N/A	N/A
10/12/2006	Blindhorse - Petersburg	1		0	20	none	n/a
10/12/2006	Blindhorse - Petersburg	2		0	0	none	n/a
10/12/2006	Blindhorse - Petersburg	3	3	1	10	none	n/a
10/13/2006	Idlewild - Whites	1	1	2	50	white water/ pool	10ft/ 25 ft
10/13/2006	North Fork mile 16-14	1		1	0	boulder	1
10/13/2006	North Fork mile 16-15	2		0	0	boulder	3
10/13/2006	North Fork mile 16-16	3	3	4	0	boulder	2
10/13/2006	Sawyers Bar - Kelly Gl	1		0	5	pool	55
10/13/2006	Sawyers Bar - Kelly Gl	2		0	0	boulder	40
10/13/2006	Sawyers Bar - Kelly Gl	3	3	3	15	none	n/a
10/13/2006	Whites to 16 mile	1		0	0	Boulder	3
10/13/2006	Whites to 16 mile	2		0	0	Boulder	3
10/13/2006	Whites to 16 mile	3	3	0	0	none	n/a
10/17/2006	Little South Fork - Blindhorse	1		0	0	w. water	20

10/17/2006	Little South Fork - Blindhorse	2	2	0		0	pool	30
10/18/2006	Big Creek - Mule Bridge	0	0	0	n/a		n/a	n/a
10/18/2006	Mule Bridge - Idlewild	1		0		5	wood	8
10/18/2006	Mule Bridge - Idlewild	2		1		35	boulder	6
10/18/2006	Mule Bridge - Idlewild	3	3	0		35	boulder	6
10/18/2006	Idlewild - Whites	1		0		1	none	n/a
10/18/2006	Idlewild - Whites	2		0		0	pool	65
10/18/2006	Idlewild - Whites	3		0		5	pool, ledge	50
10/18/2006	Idlewild - Whites	4		0		20	pool, ledge	45
10/18/2006	Idlewild - Whites	5		0		10	pool, ledge	40
10/18/2006	Idlewild - Whites	6	6	0		0	pools	40
10/19/2006	Petersburg - Eastfork	1		0		40	pool	10
10/19/2006	Petersburg - Eastfork	2		0		45	pool	15
10/19/2006	Petersburg - Eastfork	3	3	1		20	n/a	n/a
10/19/2006	East Fork	1		0		20	boulders	20
10/19/2006	East Fork	2	2	0		0	pool	20
10/19/2006	East Fork - Cecilville	1		0		50	w. water	8
10/19/2006	East Fork - Cecilville	2		1		45	pool	20
10/19/2006	East Fork - Cecilville	3		0		45	pool	20
10/19/2006	East Fork - Cecilville	4		0		45	pool	20
10/19/2006	East Fork - Cecilville	5	5	0		40	undercut willows	10
10/19/2006	Cecil - Limestone	0	0	0	n/a		n/a	n/a
? 10/15 or 9	Smith Creek - Matthews	1		0		5	undercuts + pool	15-20 / 50f
? 10/15 or 9	Smith Creek - Matthews	2		1		40	pool	20
? 10/15 or 9	Smith Creek - Matthews	3		0		35	pool	40
? 10/15 or 9	Smith Creek - Matthews	4		0		35	pool	40
? 10/15 or 9	Smith Creek - Matthews	5	5	0		35	pool	40

Total redds surveyed____________________________	190
# spring Chinook observed on redds_______________	168
Total spring Chinook observed___________________	553
Miles surveyed:	
Days Surveyed:	12
Total Surveys conducted (1 reach on 1 day = 1 survey)	44
# of reaches:	16

Enhanced Y/N	Habitat Type (pool, riffle, run,)	Spawning Area Available (L x W)	Spawning Area Used (L x W)	G.P.S. Reference #	Comments:	total # of Spring Chinook
No	top of Riffle	20x10	15x5	N/A	pool above redd w/ 7 k.s., 2 sthd	13
No	riffle	12x10	10x4	RB 1		
no	riffle	30x30	20x12	RB 2		
no	riffle	25x15	9x4	RB3		
No	riffle	50x30	12x6	RB4		24
no	run	12x5	4x3	n/a		33
n/a	n/a	n/a	n/a	n/a		5
no	run	30x3	15x3	RA 1	marginal; some cobble	
no	pool	9x5	9x5	RA 2		
no	run	9x4	9x4	RA 3	same habitat as redd #4	
no	run	8x4	8x5	RA 4		
no	run	17x4	7x4	RA 5		
no	pool	12x3	10x3	RA 6		
no	run	22x6	12x6	RA 7		
no	pool	25x6	12x6	RA 8	same habitat as redd #9	
no	run	25x6	10x5	RA 9		
no	run	16x4	8x4	RA 10		9
Yes	run	20x10	8x4			
No	run	6x4	6x4			
No	riffle	7x3	7x3			8
No	riffle	60x25	12x4		only made it to slightly past mile marker 17	
no	riffle	60x25	11x5			
no	riffle	60x20	11x4			16
no	run	25x40	5x10		nice redd	
no	pool tailout	10x20	4x7			
no	riffle	19x5	12x5			5
No	run	20x4	18x4		first four all together, not very nice redd	
No	run	20x4	18x4		not protected not defined	
No	run	20x4	18x4		all sideways - 1 lrg. Redd	
No	run	20x4	18x4			
No	riffle	4x3	3x3		small redd	
No	riffle	14x4	7x3			
No	riffle	14x4	7x4			
No	run	20x4	3x4			
No	riffle	20x20	10x3			
No	run	15x15	6x3			
No	pool/riffle	4x4	4x4			
No	run	7x5	5x3		out of flagging	
No	run	3x2	3x2			

No	run	20x20	10x5		maybe 2 redds	
No	run	15x15	5x3			5
No	run	3x3	4x3		* recruitment of gravel at mouth of Little Grizzly unfinishe	
No	run	4x2	2.5x2			
No	run	8x3	3x3		deep	
No	pool	16x5	16x4		at horseshoe bend	
No	pool	3x3	2x1		small	
No	pool	12x5	5x3			
No	run	30x5	10x3			
No	run	30x5	6x4			
No	run	9x3	5x2			
No	pool	5x2	3x2			
No	run	5x3	4x3			21
no	run	20x4	5x4			9
no	run	30x20	18x8	RB 1		
no	riffle	16x7	15x5	RB 2		
no	tailout	25x15	12x5	RB 3		
no	run	15x5	15x5	RB 4		
no	run	40x18	10x5	RB 5		
no	run	10x4	10x4	RB 6		
no	riffle	40x30	10x6	RB 7		
no	riffle	35x15	12x5	RB 8		
no	riffle	30x20	9x5	RB 9		57
No	riffle	50x15	8x3	RB 1		
No	riffle	50x15	5x3	RB 2		
No	riffle	10x4	10x4	RB 3		
No	run	10x3	8x3	RB 4		
No	riffle	20x10	8x3		(not enough satellites	
No	riffle	10x3	7x3	RB 5	saw an additional 10 spch	17
No	run	60x30	15x6	RA 1		
no	run	60x30	20x5	RA 1		15
no	run	5x10	5x8			
no	run	20x5	20x5		3 redds, 6 fish; nice pool	
no	run	20x5	20x5			
no	run	20x5	20x5			
no	run	8x10	6x7		8 lives in pool upstream	
no	riffle	5x6	5x5			
no	riffle	5x5	5x5			
no	riffle	5x7	5x7			
no	riffle	10x5	8x5			22
No	pool	40x12	15x6	RI 1	more or less 99 ft	
no	pool	15x6	15x3	RI 2	redd not complete	
No	pool tail-ou	15x5	13x5	RJ 01	no GPS point	
No	run	35x20	15x8	RJ 02		

No	riffle	20x7	18x5	RJ 03			5
No	tailout	20x10	12x8	RC 01			
No	pool tailout	25x20	8x4	RC 02			
No	riffle	25x25	20x10	RC 03			
No	riffle	20x5	15x4	RC 04			25
No	Riffle	5x6	8x8				
No	Pool	15x6	6x3			Same Location as redd #3	
No	Pool	15x6	3x2				
No	Riffle	8x9	8x6				17
No	run	25x6	9x4				
No	run	8x4	3x3				
No	pool	? Too deep	4x3			deep	
No	pool	20x4	4x3				
No	pool	12x6	8x4			Cecil	
No	riffle	5x3	5x3			Crawford	
No	run	8x3	2x2			Crawford	
No	riffle	25x4	6x3			Andy's	
No	riffle	25x4	4x3			Andy's	
No	run	16x4	10x3				
No	run	10x4	5x3				
No	run	12x5	8x4				
No	run	20x5	10x4			Bridge	
No	run	16x4	10x4				
No	pool	20x6	10x6			St. Claire	
No	pool	40x6	8x3				
No	run	12x6	8x5				58
No	Run	12x5	9x4		38	multi-fish fight on the next sight up-river	
No	Run	5x3	7x5		39		
No	Run	10x5	5x4		47		2
No	Riffle	30x30	12x5	RB 01			
No	run	20x10	10x4	RB 02			
No	run	20x8	15x6	RB 03			
No	run	20x6	14x4	RB 04			
No	run	30x30	12x5	RB 05			49
No	riffle	12x5	12x5	RB 01			
No	riffle	10x15	10x4	RB 02			
No	riffle	25x10	20x8	RB 03			10
n/a	n/a	n/a	n/a	n/a		possibly one redd at the last priv	6
No	riffle	75x8	5x4				
No	run	30x8	10x5				
No	riffle/ run	30x15	11x7			beautiful redd!	
No	run	30x10	7x4			2 slightly old redds just called one	
No	run	25x20	15x10				
No	run	30x10	5x3				

No	riffle	40x6	10x5				8
No	riffle	20x5	5x3			steelhead?	
No	run	25x10	10x3				
No	riffle	30x15	4.5x2.5			small!	
No	run	11x5	7x4.5				
No	riffle	30x10	15x8			huge! Possilby multiple redds	7
No	riffle	40x20	12x7		49	1-4 in same large riffle	
No	riffle	40x20	14x5		49		
No	riffle	40x20	12x5		49		
No	riffle	40x20	12x5		49	3 & 4 next to each other	
No	run	25x10	25x10		50		0
No	riffle	30x20	16x8	RE01			
No	riffle	30x30	20x15	RE02			
No	riffle	15x15	30x15	RE03			
No	riffle	30x12	25x5	RE04			
No	riffle	20x10	18x6	RE05			
No	riffle	20x30	10x6	RE05			
No	riffle	40x30	20x8				
No	pool	15x20	10x14				
No	riffle	30x15	15x6	RE09		L Bank	
No	riffle	15x5	10x3	RE09		R Bank	
No	riffle	50x30	20x7				17
No	riffle	30x10	16x5	RX01			
No	riffle	30x15	15x8	RD02			
No	riffle	12x6	8x5	RD02			
No	riffle	15x20	15x8	CD02			45
N/A	N/A	N/A	N/A	N/A			4
No	run	3x3	3x2			by trailhead parking lot	
No	pool	8x3	5x3			just below parking lot	
No	pool	6x4	3x2			between bridges	4
no	riffle	10x10	8x5				14
Yes	pool tailout	30x40	4x8				
Yes	pool tailout	25x60	3x6				
Yes	riffle	20x30	4x14			Below Bridge	5
no		30x10	4.5x5			smaller but rounded	
no	glide	100x10	7x4				
no	glide to riffl	50x20	10x5.5			not sure if completed	7
no	run	200x25	8x5			gorge	
no	pool	20x20	3x4				
no	pool/ riffle	20x20	3x1.5				0
no	riffle	12x4	10x3	RA01			

no	pool tailout	25x7	18x4	RA02		1
n/a	n/a	n/a	n/a			0
No	Pool	20x20	5x4			
No	Run	20x10	10x5			
No	Run	25x10	10x10			2
no (mining)	riffle	7x4	6x2.5		in a mound of smallish mine tailings, by large dredge ho	
No	glide	13x6	6x4		just below confluence with russians	
No	glide	40x15	10x4			
No	glide	40x15	7x3.5			
No	glide	40x15	6x3			
No	riffle	13x5	9x4			0
No	run	15x7	7x5			
No	run	15x7	7x5			
No	riffle	8x5	5x3			1
No	riffle	7x4	6x4			
No	riffle	30x15			two redds in same location, 1 pre	0
No	riffle	6x5	6x3			
No	PTC	20x15	9x5			
No	PTC	20x15	7x3			
No	PTC	20x15	8x4			
No	riffle	15x7	8x4			5
n/a	n/a	n/a	n/a			0
No		6x7	6x7			
No		10x7	5x7			
No		30x10	15x8			
No		30x10	15x8			
No		30x10	15x8			2

ed look to redd- fresh bear evidence = possible predation?

le

Salmon to Trinity

Species	Life Stage	Run	Source	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Chinook	Redd Construction	Spring	Al Olson																		Pa1	Pa1	Pa1				
		Fall	Al Olson																			Pa1	Pa1	Pa1	Pa1		
		Winter																									
	Egg Incubation to fry emergence	Spring	Al Olson	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2														
		Fall																									
		Winter																									
	Fry Rearing (up to 50 mm)	Spring	Al Olson							Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2											
		Fall	Charlie Chamberlain	U	U	U	U	U	U			Pa1										Pa1					
		Winter																									
	Juvenile YOY rearing (>50 mm)	Spring	Al Olson								Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pd2	Pd2	Pd2
		Fall																									
		Winter																									
	Juvenile yearling rearing	All	Al Olson	Pd2	Pd2	Pd2	Pd2	Pd2	Pd2																		
	Juvenile emigration (>50mm)	All	Al Olson	Pd2	Pd2	Pd2	Pd2	Pd2	Pd2	Pd2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Ma2	Pa2	Pa2	Pa2	Pa2	Ma2	Ma2	Pd2	Pd2	Pd2	Pd2
			Charlie Chamberlain	U	U	U	U	Pa2	Pa2 Pa4	Pa2 Pb3 Pa4	Pa2 Pb3 Pa4	Pa2 Pb3 Pa4	Ma2 Pb3 Pa4	Ma2 Mb3 Ma4	Ma2 Mb3 Ma4	Ma2 Pb3 Ma4	Pa2 Pb3 Pa4	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Pa2	Ma2	Ma2
	Adult migration	Spring	Al Olson							Pa3	Pa3	Pa3	Pa3	Pa3	Pa3												
		Fall																									
		Winter																									
	Adult holding	Spring	Al Olson											Pa?	Pa?	Pa?	Pa4	Pa4	Pa4	Pa4							
		Fall																									
		Winter																									
Coho	Redd Construction	All	Al Olson																						Pa4	Pa4	
	Egg Incubation to	All	Al Olson	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8														Pd8	Pd8	Pd8
	Fry Rearing (up to	All	Al Olson											Pa5	Pa5	Pa5	Pa5	Pa5	Pa5	Pa5	Pa5	Pa5	Pa5				
	Juvenile YOY	All	Al Olson													Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4				
	Juvenile emigration (>50mm)	All	Charlie Chamberlain					Pa2 Pa4	Pa2 Pa4	Pa2 Pa4	Pa2 Ma4	Pa2 Ma4	Pa2 Ma4	Pa2 Ma4	Pa4	Pa4											
	Adult migration	All	Al Olson																					Pa4	Pa4		
	Adult holding	All	Al Olson																				Pa4	Pa4			
Coastal Cutthroat	Redd Construction	All																									
	Egg Incubation to fry emergence	All																									
	Fry Rearing (up to 50 mm)	All																									
	1+ rearing (>50 mm)	All																									
	2+ rearing (>130 mm)	All																									
	Juvenile emigration (>50mm)	All																									
	Adult migration	All																									
	Adult holding	All																									
	Runback emigration	All																									

Salmon to Trinity

Species	Life Stage	Run	Source	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Steelhead	Redd Construction	Summer	Al Olson			Pd6	Pd6																				
		Fall																									
		Winter	Al Olson					Pd6	Pd6	Pd6	Pd6																
	Egg Incubation to fry emergence	Summer	Al Olson			Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8										
		Fall																									
		Winter																									
	Fry Rearing (up to 50 mm)	Summer																									
		Fall	Charlie Chamberlain						Aa4	Pa4	Pa4	Pa4	Pa4	Ma4	Ma4	Ma4	Pa1 Ma4	Pa4									
		Winter	Al Olson											Pb6	Pb6	Pb6	Pb6	Pb6	Pb6	Pb6	Pb6						
	1+ rearing (>50 mm)	All	Al Olson	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8	Pb6	Pb6	Pb6	Pb6	Pb6	Pb6	Pb6	Pb6	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8
			Charlie Chamberlain						Pa4	Pa4	Ma4	Ma4	Pa4	Pa4	Pa4	Pa4	Pa1 Pa4	Pa4				Pa1					
	2+ and older rearing (>130 mm)	All	Al Olson	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8					Pb6	Pb6	Pb6	Pb6	Pb6	Pb6	Pb6	Pb6						
			Charlie Chamberlain						Ma4	Ma4	Ma4	Ma4	Pa4	Pa4	Pa4	Pd	Pa1					Pa1					
	Juvenile emigration (>50mm, all ages)	All	Charlie Chamberlain					Pa2	Ma2 Pa4	Ma2 Mb3 Pa4	Ma2 Mb3 Ma4	Pa2 Mb3 Ma4	Pa2 Pb3 Ma4	Pa2 Pb3 Ma4	Pa2 Pb3 Pa4	Pa2 Pb3 Pa4	Pa2 Pb3 Pa4										
	Adult migration	Summer																									
		Fall																									
		Winter																									
	Adult holding	Summer	Al Olson	Pd8	Pd8	Pd8	Pd8							Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pd8	Pd8
		Fall																									
		Winter	Al Olson	Pd8	Pd8	Pd8	Pd8	Pd8	Pd8											Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pd8	Pd8
	Half-pounder migration and holding	All	Al Olson																	Pa4	Pa4	Pa4	Pa4	Pa4	Pa4	Pd8	Pd8
	Runback emigration	All	Al Olson			Pb7	Pb7	Pb7	Pb7	Pb7	Pb7	Pb7															
Grean Sturgeon	Spawning	All																									
	Egg Incubation	All																									
	Juvenile rearing	All																									
	Juvenile emigration	All	Charlie Chamberlain											Pa4	Pa4	Ma4	Ma4	Pa4									
	Adult migration	All																									
	Adult holding	All												Pa3	Pa3												
Pacific Lamprey	Spawning	All										Pa3	Pa3														
	Egg Incubation	All																									
	Juvenile rearing	All																									
	Juvenile emigration	All	Charlie Chamberlain						Ma4	Ma4	Ma4	Ma4	Pa4	Pa4	Pa4	Pa4	Pa4										
	Adult migration	All																									
	Adult holding	All																									

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December 3, 2009

Mark Stopher
California Department of Fish and Game
601 Locust Street
Redding, CA 96001

Re: Comments on the Department's Notice of Preparation of a Draft Subsequent Environmental Impact Report Regarding Suction Dredge Mining Rules

Dear Mr. Stopher:

The Sierra Fund is pleased to make the following comments on the Notice of Preparation of a Draft Subsequent Environmental Impact Report (SEIR) regarding suction dredge mining rules.

The Sierra Fund is a nonprofit community foundation, with the mission to increase and organize investment in the natural and human resources of the Sierra Nevada. Since 2006, The Sierra Fund has been working to bring more attention to the environmental and health impacts of historic mining, through our Mining Initiative which is based upon recommendations from our 2008 report entitled *Mining's Toxic Legacy*. (The full report can be viewed on our website www.sierrafund.org/campaigns/mining). We are currently engaged in a Sierra-wide effort to raise public awareness of the problems presented by abandoned mines, mine waste piles, mercury, and other toxins left over from mining in the region, and to involve all stakeholders in designing workable solutions to these problems.

We joined with a number of other organizations in developing collaborative comments on the SEIR, outlining a number of other comments and recommendations for changes. These comments, which are being submitted by the Karuk Tribe and large coalition of organizations, reflect our concerns as well.

In addition, we are here submitting comments focusing on mercury issues that are pertinent to the SEIR. The following comments about the technical elements of the SEIR that address mercury hazards have been developed in large part by The Sierra Fund's Science Director, Carrie Monohan, Ph.D. (see Vitae, attached).

We believe that the broadest interpretation should be made of the scope of the SEIR that was ordered by the California court. Since "new information, which was not known and could not have been known at the time the [original] environmental impact report was certified as complete has become available" (Public Resources Code 21166 (c)) concerning the deleterious and cumulative impact of suction dredge gold mining, the scope of the SEIR must respond to this new information, especially around Air Quality, Biological Resources, Hazards and Hazardous Materials, and Water Quality and Toxicology. We outline some of this new information in the following comments. Our comments on the SEIR are focused on specific changes in the SEIR Environmental Check List that we would like to see adopted.

Comment #1: The Air Quality discussion inadequately characterizes the potential air quality impacts of suction dredging by failing to discuss the impact of mercury that is retorted as part of gold recovery.

The SEIR in section 5.5.7 Processing of Material states:

> Generally, the sluice box does not need to be cleaned until gold is beginning to be deposited below the upper third of the box ...Normal conditions require that the sluice box be cleaned only once or twice per day... The concentrates are filtered through a series of screens and/or panned to work the concentrates down to small batches containing gold, which then can be processed through a final dry process... This final procedure involves the drying of concentrates, filtering, and physical separation using magnets and small hand tools. In addition, chemical separation, by means of mercury and nitric acid, may be used for the amalgamation process...After the mercury has gathered in the gold, it is removed by dissolving it in nitric acid or by driving it off as a vapor by heat, leaving the gold behind. While mercury should be treated as a hazardous waste, some miners collect and store it, while others dispose of it by vaporizing it in a cooking pan on a camp stove.

Despite this information, which clearly points out that mercury is allowed to vaporize into the atmosphere at suction dredge mining operations, and a great deal of public testimony that mercury vapor is commonly released on-site as a part of routine suction dredging for gold, there is no mention in the air quality environmental checklist about this practice or its air quality impacts.

Mercury vapor releases have been acknowledged as a significant air quality impact. Mercury discharges into air are regulated by the Clean Air Act. The Clean Air Act regulates 188 air toxics, also known as "hazardous air pollutants." Mercury is one of these air toxics. The Act directs the EPA to establish technology-based standards for certain sources that emit these air toxics. Those sources also are required to obtain Clean Air Act operating permits and to comply with all applicable emission standards.

Mercury is very dangerous when inhaled. Acute exposure to mercury vapor leads to pulmonary and central nervous system effects. Inhalation of high levels of mercury vapor can cause the onset of symptoms such as cough, dyspnea, chest pain, nausea, vomiting, diarrhea, fever and a metallic taste in the mouth. These symptoms can progress to interstitial pneumonitis and pulmonary edema. Young children are at the greatest risk of developing pulmonary toxicity.

Recommendation: The acknowledged common practice of retorting mercury on-site as part of routine processing of materials from suction dredge mining has a potentially significant impact on air quality and public health and must be analyzed further in the SEIR.

Comment #2: The Biological Resources checklist understates the problems of heavy metal contamination on fish embryos and the stream benthic community.

Water quality sustains ecological processes that support fish populations, vegetation, wetlands, and birdlife. Water quality is the building block of the aquatic food chain and the impacts of mercury pollution can be seen in fish and birds that depend on aquatic food chain for their food source. Suction dredge mining in waterways with residual mercury has irreversible and long lasting deleterious effect to the environment and to fish because it degrades water quality.

Mercury takes on different forms in the environment. Quicksilver or elemental mercury is a visible form. Methyl mercury is a particularly toxic form that bioaccumulates in the food chain. Mercury can also be present in the air and water in particles too small to see. The microscopic particles of mercury in the water are deleterious to the entire aquatic food chain because they are easily accessed by bacteria.

Bacteria will use mercury and in so doing create methyl mercury. Specifically, sulfur reducing bacteria in warm anoxic environments will reduce mercury and create methyl mercury. Bacteria form the bottom of the food chain. If the bottom of the food chain is polluted with mercury then that contamination is translated to every level of the food chain.

The impacts of methyl mercury contamination in the aquatic food chain are still being studied. However as methyl mercury moves up the food chain it bio-accumulates and biomagnifies and can be found at very high levels in large predatory fish such as bass (USGS Open File Report 00-367, 1999). The Water Board Staff report of May 2005 concludes that the recreational suction dredge that was tested recovered 98% of the mercury it disturbed, but that the mercury concentrations in the fine and suspended sediment in the dredge effluent were more than ten times higher than that needed to classify it as a hazardous waste. This report also states that the floured mercury in fine sediment and mercury attached to clay particles in suspended sediment that were released by the dredge can be carried by the river to environments where mercury methylation occurs (Humphreys, 2005).

In the section on heavy metal contamination the report notes that:

> Suction dredging activities can result in the discharge of mercury (Hg) or other toxic contaminants. These discharges may cause adverse impacts to aquatic organisms and increase the risk of mercury bioaccumulation in the food chain. Strong experimental evidence exists for the adverse effects of mercury on fish reproductive capacity (e.g., decline in spawning activity and fecundity, impaired gonadal development, or testiticular atrophy) (Kirubagaran and Joy 1988; Wester 1991; Kirubagaran and Joy 1992; Friedmann, et al. 1996; Hammerschmidt et al. 2002). This is considered a potentially significant impact and will be analyzed further in the SEIR.

Unfortunately, the environmental checklist only refers to this problem affecting juvenile and adult fish. Despite evidence that mercury contamination affects the entire food chain and gets into the tissues of all organisms that are exposed, there is no discussion on the impacts of this exposure of fish embryos.

Further, the checklist states that effects of dredging on stream benthic community are localized, in that they do not extend beyond the immediate area dredged. This disregards the impact of mobilized, reactive mercury on stream benthic community at a distance from the dredging site.

We can find no studies specifically designed to determine if suction dredging contributes to high fish tissue mercury levels. Also, we can find no studies that have been performed to determine whether or not suction dredging affects levels of mercury or methyl-mercury in biota on-site or downstream of dredging operations. These studies need to be done to determine the effect that recreational suction dredge mining has on mercury in fish tissues, and the extent to which this effect extends to downstream environments. No recreational suction dredge mining in the Gold County should be allowed until these questions can be answered.

Recommendation: Reactive mercury that has been mobilized by suction dredge mining has potentially significant impacts on fish embryos and stream benthic communities. These impacts must be studied and analyzed further in the SEIR.

Comment #3: The Hazards and Hazardous Materials checklist fails to discuss fully the potential hazards of mercury both used and recovered by suction dredge miners.

In the discussion of hazards, the SEIR does describe some potential hazards associated with nitric acid and mercury, stating that when these materials are used or disposed of "improperly", they may

> ...pose a risk to public health and safety from contamination or exposure. This includes accidental or purposeful spillage into waterways and/or upland areas. Because suction dredging and related activities are associated with the routine use of hazardous materials, the implementation of the Program could potentially endanger the health of the public or the environment.

The SEIR should not only focus on "improper" disposal of mercury, but must instead look at every way that mercury in the suction dredge process is handled, including storage on-site, transportation of the material to and from the site, how mercury is applied and retorted, and how it is disposed of.

Mercury is a highly toxic material, and is regulated under Proposition 65 and numerous other statutes. If a blood pressure cuff breaks in a doctor's office spilling mercury, a Proposition 65 warning is required including routine notification of the public through the newspaper of record, and emergency hazard response professionals are called to the scene. Similar precautions need to be taken with mercury used in suction dredge mining operations.

There are two ways that mercury is part of suction dredge mining:

i. Use of "clean mercury" and nitric acid as part of the mining process: The use of nitric acid to process the concentrates creates a waste product, mercuric nitrate, that is water soluble, extremely acidic, and toxic to the environment. Mercuric nitrate is mercury that has been oxidized and is essentially one step closer to becoming methyl mercury. Mercuric nitrate is a hazardous waste that has been found in glass jugs in recreational suction dredgers' camps. Mercury that is brought to the suction dredge operation has the potential to introduce more mercury into the environment.

Mercuric nitrate is the substance responsible for "Mad Hatters" disease, a neurologic disorder associated with exposure to inorganic and organic forms of mercury. Chronic exposure to inorganic mercury manifests as mental confusion, prominent behavioral changes (including psychosis), and abnormal movement. Alkyl mercury poisoning may occur through ingestion of contaminated seafood or grain, and its characteristic features include vision loss, deafness and other neurological impacts. Exposure to mercury has been found to be particularly damaging to children, especially in the developing fetus. Acute intoxication may be associated with gastrointestinal disturbances, mental status changes, even death.

ii. Mercury recovered from creeks, rivers and other water bodies as part of the suction dredge mining process: An estimated 26 million pounds of mercury were used to extract gold from ore in California, most of it in the Sierra Nevada Gold Country (Alpers et al, 2005). Of this, an estimated 10 million pounds were lost to the environment in placer mining operations and another 3 million pounds were lost from hard rock mining (Churchill, 2000).

Elemental mercury or "quicksilver" is still commonly encountered in Sierra watersheds. In the suction dredging process, miners remove gravels from the riverbed with a suction hose powered by an engine, and then use pans or other methods to retrieve the gold. Suction dredgers often encounter mercury and gold-mercury amalgam, which tend to fall into the cracks of the riverbed like gold. Dredgers collect the mercury and amalgam, and retort it or treat it with nitric acid to release any gold that may have amalgamated with the mercury.

Recommendation: The hazards associated with nitric acid and mercury use as part of routine suction dredge gold mining including the handling, transportation, storage, use and disposal of mercury must be analyzed further in the SEIR.

Comment #4: The Hydrology and Water Quality section needs to be revised to address the many hazards associated with mercury and suction dredge gold mining.

The SEIR discussion about the impacts of suction dredge mining practices on mercury and water quality needs to be greatly expanded.

Under the Clean Water Act, states adopt water quality standards for their rivers, streams, lakes, and wetlands. These standards identify levels for pollutants, including mercury, which must be met in order to protect human health, fish, and wildlife. No person may discharge pollutants, including mercury, into waters unless the person has a permit.

The National Pollutant Discharge Elimination System (NPDES) is the permit system established by the Clean Water Act (CWA) to regulate direct wastewater discharges from wastewater treatment plants and industry. Wastewater dischargers may be required to comply with a specific mercury discharge limit (concentration and/or mass limit) or may only be required to monitor their discharges for mercury. Local discharge limits in California for mercury range from 0 to 0.1 ppm (or mg/l). The Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs determine what level of pollutant load would be consistent with meeting water quality standards. The TMDL regulatory process also allocates acceptable loads among sources of the relevant pollutant.

A single recreational suction dredge operating 8 hours per day for 30 days disturbing 1-10sq/meters of stream bed in an area with a background concentration of mercury in the stream bed of 30ppb-1ppm would be responsible for mobilizing more mercury than the amount of mercury mobilized over the course of a dry water year for an entire watershed (Alpers, personal communication 12/2/09; CVWQCB 2008). NPDES permits have not been given to recreational suction dredgers nor have TMDLs been developed for the waterways in which recreation suction dredging currently takes place in California. As such, recreational suction dredging in areas with mercury contamination is likely in violation of the Clean Water Act.

Recreational suction dredging exacerbates the existing mercury contamination problems in water bodies and increases the levels of mercury contamination in fish for the following reasons:

- **Dredging exposes encapsulated mercury.** Suction dredge miners target deep river crevices where heavy materials including gold and mercury can be found because they have not been disturbed by natural processes for many years. Dredging these areas of "pay dirt" disturbs mercury that would otherwise have remained encapsulated.

- **Floured mercury is released back into the water body.** The Project Description of recreational suction dredging acknowledges the fact that miners encounter mercury when operating dredges. This does not address the fact that the mercury that is not captured by the dredge is instead floured by the dredge and re-released back into the water body in a form that is more likely to methylate and be incorporated into the food chain (RWQCB, 2005). The floured mercury that is released back into the water body has been changed by the dredging activity and is considered more likely to methylate because as it travels through the intake hose, educator, and header box the mercury is disturbed and broken up into very small pieces. These small pieces, or floured mercury, are likely to be carried in suspension long distances from the dredging operation, and are readily available to bacteria because it is small (high surface area to volume ratio), oxygenated, and dispersed. The increase in surface area from changing large blobs of mercury to fine-grained floured mercury likely increases the rate of mercury oxidation. The oxidation of these fine mercury particles may be further enhanced by transport in an oxygenated water column of a flowing river. It is the oxidized mercury that is considered the "reactive" fraction that is most available to mercury-methylating bacteria.

- **Mercury travels downstream.** The mercury that is not captured by the dredge but is instead discharged into the water body travels downstream in suspension through varied and diverse habitats where it can be taken up by bacteria that live on the banks of the river and form floodplain wetland environments. The floodplain environment of upland rivers includes the entire 100 year floodplain because this is the area that is inundated by storm events when the rivers swell and overtop the banks. It follows that dredge effluent containing mercury deposited anywhere between the high water mark and the 100 year floodplain is likely to contaminate the aquatic food chain. The literature review states that:

  > Dissolved Hg, floured liquid Hg, and fine particle/colloid bound Hg may be transported long distances to environments favorable to methylation, e.g. wetlands, Yolo Bypass, or the Delta. It is well-known that methylation occurs in these environments (e.g., CVRWQCB 2008).

  In addition, it is important to note that mercury may not need to travel long distances to be methylated, in fact methylation is likely to occur in the hyporheic zone, in backwater channels and as benthic exchange in many carbon-rich, low-oxygen environments.

- **Recreational suction dredging takes place during the warm summer months of heightened biological activity.** Recreational suction dredges disturb and release mercury primarily in the summer months when the water is warm and the flows are low and there are an abundance of bacteria-rich environments where mercury methylation is likely to occur (Alpers et al., 2008; Stewart et al., 2008). Once mercury gets into fish it can result in impaired water body listings or 303(d) listings, and fish consumption advisories. There are numerous fish consumption advisories for fish in mercury impaired water bodies in the Sierra as a result of mercury contamination (OEHHA, 2009).

- **Further studies need to be done to understand mercury methylation.** The different environments, times of year and extent of mercury methylation has not been studied, nor have the effects of recreational suction dredging on methylation in these different environments. Until the areas with the greatest mercury contamination and methylation potential are known it is prudent to not operate recreational suction dredges, otherwise the mercury contamination problem in California may worsen.

Recommendation: The effect of recreational suction dredging on water quality should be considered first and foremost among the impacts of the project. The impacts of disturbing and re-distributing mercury in the environment, on water quality, wildlife health and fish populations need to be fully analyzed in the SEIR.

Comment #5: Many of the concerns raised in our comments about the SEIR are focused on public health, water and air quality and other issues outside of the charge of the lead agency.

The issues we raise in the above comments are in some cases outside of the jurisdiction of the California Department of Fish and Game, and are instead regulated by the State Water Resources Control Board, Department of Toxic Substances Control, and the California Air Resources Board. Their expertise and guidance is needed in this effort.

Recommendation: State agencies charged with protecting air and water quality must be part of the regulatory mechanism permitting suction dredge mining, and should be included in the development of the Environmental Impact Review as well as developing any new regulations or procedures promulgated as part of this effort.

In Conclusion
Thank you for this opportunity to comment. Please feel free to call if you have any questions about these materials.

Sincerely,

Elizabeth "Izzy" Martin
CEO
The Sierra Fund

References used in these comments

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Central Valley Regional Water Quality Control Board *Amendments To The Water Quality Control Plan For The Sacramento River And San Joaquin River Basins For The Control Of Methylmercury And Total Mercury In The Sacramento-San Joaquin Delta Estuary,* Staff report Draft report for Public review February 2008)

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Key Qualifications
Dr. Monohan received her Ph.D. from the University of Washington College of Forest Resources, Center for Water and Watershed Studies. Her dissertation work addressed the relationship between water quality in agricultural streams and diminishing salmon habitat. Since completing her dissertation she has contributed to the scientific and regulatory communities' understanding of the legacy impacts from historical gold mining in California, specifically, the effects of mercury, the process of mercury methylation and potential human exposure routes.

EDUCATION:

2004 Ph.D. Forest Engineering and Hydrology, College of Forest Resources, Center for Waterand Watershed Studies, University of Washington, Seattle, Washington. USA Multi-disciplinary degree with emphasis on water quality.

2000 B.Sc. (Honors), Biology, Robert D. Clark Honors College, University of Oregon, USA

RELATED POSITIONS HELD:

2007-date *Science Director, The Sierra Fund, Nevada City, CA*
Director of Science for the Mining Project Initiative to address legacy mining issues across the Sierra Nevada mountain range, issues include both human exposure routes and environmental degradation.

2008-date *Consulting Scientist, The Nevada Irrigation District, Grass Valley, CA*
Development, design, and permitting of a reservoir sediment and mercury removal project.

2006-2009 Consulting *Hydrologist, Friends of Deer Creek, Nevada City, CA*
Position is the project manager for a US Environmental Protection Agency funded Brownfield Project.

2004-2008 *Senior River Scientist, The Natural Heritage Institute.100 Pine St. Suite 1550, San Francisco, CA 94111* Project manager for the development of a Mountain Meadows Integrated Regional Watershed Management Plan and development of environmental flow targets for the Sacramento and Feather Rivers.

SELECTED TECHNICAL REPORTS AND PAPERS:

Monohan, C. and J. Cain. 2008 Estimating Environmental Flow Objectives for the Sacramento and Feather Rivers. Report produced for the Conjunctive Use Integrated Regional Watershed Management Plan. Submitted to the Department of Water Resources.

Henson S., C. Monohan and J. Hild. 2008. Deer Creek Watershed Mercury Survey. Submitted to the Regional Water Quality Control Board, Total Maximum Daily Load Unit.

Cornwell, Kevin, K. Brown, and C. Monohan 2007. Mountain Meadows and their contribution to the Sierra Nevada Water Resources. EOS Trans. AGU, 88(52) Fall Meet. Suppl. Abstract H31D-0642.

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NMFS Technical Report, October 2001. Riley, S., P. Kiffney, and C. Inman. 2001. Habitat inventory and salmonid stock assessment in the Cedar River and tributaries. Submitted to Seattle Public Utilities

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Independent Study, Fall 1997. Inman, C. A Fish Biodiversity Study in a Flood Plain Habitat of the Okavango Delta. Heil Openheimer Okavango Research Center. School for International Training. Botswana, Africa.

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Ms. Martin has years of experience in evaluating environmental impact reports as a decision maker on local government boards. In addition, she has developed nationally recognized expertise in the impacts of mercury from legacy gold mining, including being asked to serve as an expert witness in Congressional Hearings held in November 2009 on the issue of abandoned mines and mercury in California.

RELATED EXPERIENCE

<u>CEO</u> The Sierra Fund	<u>December 2004 -</u> present
<u>Nevada County Supervisor, District 4</u> Nevada County, California	<u>January 1999 -</u> January 2003
<u>Nevada County Planning Commissioner</u> Nevada County, California	<u>1991 – 1993, again from</u> 1996 - 1998

EDUCATION

B.S, Environmental Policy Analysis, magna cum laude, UC Davis 1979

RELATED LEADERSHIP POSITIONS

Chair, Nevada County Board of Supervisors, 2001
Nevada Power Authority, 2001 - 2002
Nevada County Local Area Formation Commission 1999 - 2003
Nevada County Solid & Hazardous Waste Commission 1999 – 2003
Chair, Nevada County Planning Commission, 1996
Sierra Nevada Working Group, Resources Agency 2000 - 2002

SELECTED PUBLICATIONS

Principal Author, *Mining's Toxic Legacy: An Initiative to Address Mining Toxins in the Sierra Nevada,* published March 2008 by The Sierra Fund

Vulcan
Materials Company

Western Division

December 3, 2009

Mr. Mark Stopher
Department of Fish and Game
601 Locust Street
Redding, CA 96001

Re: Comment on Scope of Suction Dredging Permitting Program Subsequent Environmental Impact Report and Related Regulations

Dear Mr. Stopher:

We appreciate this opportunity to comment on the scope of the Department of Fish and Game's (DFG) subsequent environmental impact report (SEIR) for its suction dredging permitting program under California Fish & Game Code Section 5653.

Vulcan Materials Company conducts mining operations to extract raw materials that it then converts into aggregates and other products, such as asphalt, ready-mixed concrete and cement, the basic material used to construct infrastructure and public works projects. We take very seriously our obligation to be stewards of the environment and its resources, a commitment that is reflected at the core of our corporate mission and demonstrated by, among other things, our many projects to restore habitat for protected and endangered species in such places as Colton Dunes, Cajon Creek, Azusa Rock and the San Joaquin River Valley.

We support DFG's efforts to update its suction dredging permitting program. Like DFG, we are concerned that suction dredging operations that do not undergo environmental review - such as those conducted by individual goldminers - may pose a threat to fragile fish populations not presently accounted for under the existing program. It was this concern that motivated the Legislature to enact Fish & Game Code Section 5653.1, which imposes a moratorium on suction dredging for instream mining purposes until DFG completes its environmental review and updates its regulations.[1] So that the moratorium and DFG's SEIR and rulemaking process do not indirectly impede projects with restorative value and those for which there is an obvious critical need, it is imperative that DFG's SEIR be properly scoped so that is can proceed expeditiously. To that end, DFG's SEIR should be confined to an analysis of suction dredging operations that escape environmental review under other state and federal laws.

[1] Please see Attachment A discussing the legislative and related history for Section 5653.1.

I. THE MORATORIUM DOES NOT APPLY TO RESTORATION AND MAINTENANCE PROJECTS, AND THE SEIR ANALYSIS SHOULD NOT INCLUDE SUCH PROJECTS

The scope of DFG's SEIR and rulemaking should be focused on those instream mining operations contemplated by the moratorium.

The moratorium legislation specifically states that it:

> *Applies only to vacuum and suction dredging activities conducted for instream mining purposes. This section does not expand or provide new authority for the department to close or regulate suction dredging conducted for regular maintenance of energy or water supply management infrastructure, flood control, or navigational purposes governed by other state or federal law.* Fish & Game Code Section 5653.1.

Thus, the moratorium only applies to suction dredging for instream mining purposes and does not reach projects with restoration, maintenance, or navigation purposes. To the extent materials extracted for such projects also have financial value (which may help fund the project), such projects are nevertheless outside the reach of the moratorium. As reflected in the language of the moratorium quoted above, the real concern is that some instream mining operations are not otherwise governed by state and federal law and therefore may not be subject to appropriate environmental review. The SEIR's focus should be on these operations only.

II. THE SCOPE OF THE SEIR SHOULD FOCUS ON SUCTION DREDGING OPERATIONS NOT OTHERWISE SUBJECT TO ENVIRONMENTAL REVIEW

A. An unnecessarily overbroad SEIR scope could delay or increase the environmental or financial costs of good projects

This month Governor Schwarzenegger signed into law a historic package of water legislation aimed at addressing the state's water crisis.[2] Among other things, the legislation provides for an $11.1 billion water bond to fund water storage ($3 BB), Delta restoration ($2.55 BB), restoration in 21 watersheds other than the Delta ($1.7 BB), regional water management ($1.4 BB), groundwater cleanup ($1 BB), and water infrastructure projects. For some of these projects, suction dredging will be the best technology to use. Moreover, although Section 5653.1 specifically excepts from the prohibition suction dredging "conducted for regular maintenance of energy or water supply management infrastructure, flood control, or navigational purposes governed by other state or federal law," it is not clear that all of these projects will fall within the scope of the exception.

Therefore, to the extent DFG's SEIR and rulemaking process is protracted, and the suction dredging moratorium cannot be lifted, DFG's process could indirectly escalate the costs of or effectively stymie these much-needed projects by eliminating suction dredging as an

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2 Gov. Schwarzenegger signed SBX7_1, SBX7_2, SBX7_6, SBX7_7, and SBX7_8. *See generally* http://gov.ca.gov/bills/.

option. DFG initially intended to generate an amended EIR by July 2008, as ordered by the Alameda Superior Court in *Karuk Tribe of California v. California Department of Fish and Game* (*Karuk*).[3] Then, after determining that a SEIR would be necessary, DFG proposed a draft schedule to the court in which the SEIR would be certified in October 2009, which has already passed. DFG's current predictions are that the amended regulations will not be in effect until sometime in Spring 2011. Even if DFG meets this schedule, the moratorium will remain in effect for at least a year and a half; so that it is in effect no longer than necessary, DFG should carefully scope its SEIR.

B. <u>Focusing the scope of the SEIR on suction dredging operations that are not already subject to environmental review is consistent with judicial and legislative intent and DFG's regulatory authority</u>

We ask that DFG focus the scope of the SEIR on an analysis of suction dredging operations that are not already subject to environmental review under other state and federal laws. This approach is consistent with the intent and purposes of the moratorium legislation and the two related judicial decisions that preceded it in 2006, *Karuk Tribe of California v. California Department of Fish and Game* (*Karuk*), and 2009, *Hillman v. California Department of Fish and Game* (*Hillman*)[4], as well as DFG's regulatory authority.

The focus of the *Karuk* case was concern that individual gold miners receiving permits from DFG pursuant to Fish and Game Code Section 5653 were deleteriously affecting Coho salmon populations in the Klamath, Scott and Salmon Rivers.[5] When the issue returned to the court again in 2008 via the *Hillman* lawsuit, the focus again was on DFG's granting of permits to individuals under Section 5653. In *Hillman*, the court zeroed in on the fact that DFG's issuance of permits must be predicated on environmental review, as it is not a purely ministerial action, and it was the absence of environmental review that necessitated halting DFG's permit program.

In contrast, suction dredging operations that undergo environmental review would not trigger the insufficient-environmental-review problem that *Karuk* and *Hillman* sought to address. Therefore, these kinds of suction dredging operations should be outside the proper scope of DFG's SEIR.

Similarly, it is clear the moratorium legislation did not intend to force DFG to conduct a broader review than that contemplated by the court, since it specifically refers to the *Karuk* decision.[6] In addition, the legislative history repeatedly refers to the problem of "small-scale

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3 RG05 211597, Order and Consent Judgment issued December 20, 2006.

4 No. RG09-434444

5 *Id.* (finding that "new information which was not reasonably available to the Department at the time it completed the 1994 EIR that issuing suction dredge mining permits under the current regulations could result in environmental impacts different or more severe than the impacts evaluated in the 1994 EIR").

6 Fish & Game Code Section 5653.1(b)(1).

gold mining operations" and "recreational goldmining" [7], operations that traditionally fall through the regulatory cracks.

Further, DFG's suction dredge permitting authority is limited by Fish & Game Code Section 5653 *et seq* to "persons", not business entities.[8] The moratorium legislation did not expand this regulatory authority.[9] In fact, Section 5653.1 explicitly states that it "does not expand or provide new authority for the department[.] As such, it is clear the Legislature's intent was to focus DFG on suction dredging operations that are not otherwise regulated, leaving those already subject to environmental review outside the proper scope of the SEIR.

III. CONCLUSION

Beneficial and environmentally sound projects could be impeded by the broad moratorium that remains in place until DFG's SEIR and rulemaking are complete. To avoid this unintended consequence, DFG's SEIR should hone its SEIR analysis to capture only those suction dredging operations not subject to environmental review under other DFG programs or by other agencies.

Thank you for your attention to this matter. You may either contact Brian Anderson at 323-474-3205, or me at 323-474-3202, if you have any questions.

Sincerely,

Michael Linton
VP Properties and Land Development

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7 *See* Attachment A.

8 Fish & Game Code Section 5653.8.

9 Fish & Game Code Section 5653.1(c).

ATTACHMENT A

RELEVANT LEGISLATIVE HISTORY FOR SENATE BILL 670 (WIGGINS), CHAPTERED AT FISH & GAME CODE SECTION 5653.1

- **Key Message**: The Department of Fish and Game's ("DFG") new suction dredging regulations should target individual gold miners. Business entities whose dredging activities are regulated under other state and federal laws are outside the scope of DFG's regulatory authority and the intended scope of the environmental review to be conducted of DFG's suction dredging permitting program.

- **Legal and Legislative Support:**

  I. The Wiggins Bill is specifically concerned with gold mining.

  "This bill clarifies the process that DFG will follow to develop new regulations for the suction gold mining program." Senate Rules Committee, Bill Analysis.

  "Suction dredging is used to remove sediment from channels boarded by levees, to maintain a river as navigable for larger vessels, and as part of a small-scale gold mining operation. It is the latter use of suction dredging that is the focus of this bill." Assembly Committee on Appropriations, Bill Analysis.

  "Vacuum and suction gold dredging is a process by which power equipment is used to vacuum up sediment from the streambeds of rivers, creeks or other water bodies to search for gold. DFG issues permits for use of motorized vacuum or suction dredge equipment for recreational gold mining in California rivers and streams." Assembly Committee on Water, Parks & Wildlife, Bill Analysis.

  II. The Wiggins Bill is not concerned with suction dredging activities that are otherwise regulated.

  "Dredging permits issued by DFG state that the applicant will comply with all appropriate water quality regulations. However, the State Water Resources Control Board does not have a program to regulate suction dredging." Senate Rules Committee, Bill Analysis.

  "The author notes the state's salmon fisheries are in crisis, with salmon fishing banned along the California coast for the second year in a row, affecting the livelihoods of thousands of commercial fishermen and others, while status quo has been allowed for recreational gold mining." Assembly Floor, Bill Analysis.

III. Existing Fish & Game Code provisions concerning suction dredging remain unchanged; they limit DFG's regulatory authority to the issuance of permits to persons and not large, commercial operations.

"The use of any vacuum or suction dredge equipment by any person in any river, stream, or lake of this state is prohibited, except as authorized under a permit issued to that person by the department[.]" Fish & Game Code Section 5653(a).

"For purposes of Sections 5653 and 5653.3, 'person' does not include a partnership, corporation, or other type of association." Fish & Game Code Section 5653.8.

IV. The Fish & Game Code provisions concerning suction dredge mining were enacted specifically to address the problem of individual gold miners.

See, e.g., "vacuum or suction devices ... to carry out gold dredging operations ...in rivers and streams." Bill Analysis of Senate Bill No. 1459 (Arnold), as amended in the Senate May 26, 1961.

"[I]ntent of this bill" is to regulate and control the use of "small portable dredging equipment used for gold recovery by skin divers in streams." Letter to Honorable Edmund G. Brown, Governor, from Senator Stanley Arnold (June 16, 1961).

The bill is "designed to control the activities of the 'weekend gold miners' who are using portable suction dredges . . . in the stream beds of northern and central part of the state." State of California Interdepartmental Communication to the Honorable Edmund G. Brown, Governor, from the Director, Department of Fish and Game, Subject: Senate Bill No. 1459 (June 28, 1961).